Commercial Woods of the Philippines: Their Preparation and Uses

By E. E. Schneider
Wood Expert, Bureau of Forestry

Department of the Interior
Bureau of Forestry

Bulletin No. 14

W. F. Sherfesee, Director of Forestry

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LETTER OF TRANSMITTAL.

MANILA, *January 10, 1916.*

SIR: I have the honor to transmit herewith a manuscript entitled "Commercial Woods of the Philippines: Their Preparation and Uses," by E. E. Schneider, wood expert in this Bureau, and to recommend that it be published as Bulletin No. 14 of the Bureau of Forestry.

The figures and plates are in all cases necessary for a proper understanding of the text.

Very respectfully,

W. F. SHERFESEE,
Director of Forestry.

The Honorable
the SECRETARY OF THE INTERIOR,
Manila, P. I.

INTRODUCTION.

The present bulletin, "Commercial Woods of the Philippines," has been prepared primarily to furnish to wood users all over the world complete and authentic information concerning the woods of the Philippine Archipelago either now used in commercial quantities or which, if their qualities were better known, would make such a place for themselves. The information the bulletin contains represents data collected during the fifteen years which the present Bureau of Forestry has been in existence. As even a cursory reading of the descriptions of the species will show, the data are very voluminous and in many cases from their very nature more or less tentative.

The rather full discussions concerning the qualities of woods in general, and the detailed advice given for the seasoning, staining, and other preparatory processes for Philippine woods in particular, have been included in order to enable the user to obtain the best and most satisfactory results even although skilled and experienced woodworkers are not available. It is hoped that this feature of the bulletin will prove of practical assistance.

In such a compilation as this it is very likely that many errors, large or small, have crept in; and it may well be that information of importance to the wood user has been omitted through oversight, despite the care which has been exercised. Comments and suggestions are therefore particularly requested, it being specially important that attention should be called to all misstatements of fact.

All communications should be addressed to "The Director of Forestry, Manila," and will be heartily appreciated and given full consideration in order that each successive edition of the bulletin may be an improvement over the last.

With few exceptions, all of the plates were originally published in "Indo-Malayan Woods" by Dr. F. W. Foxworthy (issued by the Bureau of Science, Manila), or in "The Felling, Seasoning, and Sawing of Timber," by the author of the present bulletin and published in "The Philippine Craftsman" by the Bureau of Education; and grateful recognition is here made of the courtesy accorded this Bureau in permitting their republication.

W. F. SHERFESEE,
Director of Forestry.

PREFACE.

The present work is intended to take the place of Bulletin No. 11 of the Bureau of Forestry, "The Uses of Philippine Woods," the supply of which has been exhausted. It seemed desirable to extend considerably the scope of the work, including much new material as well as a good deal of material already published which, it is believed, would add to the usefulness of the publication. Accordingly, the publications of this Bureau and of the Bureau of Science have been freely drawn upon. The principal publications which have been used are:

1. "The Forests of the Philippines," by Dr. H. N. Whitford, published by this Bureau in 1911, as Bulletin No. 10.
2. "Philippine Woods" and "Indo-Malayan Woods," by Dr. F. W. Foxworthy, published in the Philippine Journal of Science in 1907 and 1911.
3. "Mechanical Tests of Thirty-Four Philippine Woods," by R. Gardner, published by this Bureau in 1906, as Bulletin No. 4. The tabular statement of the tests was republished in Bulletin No. 10 and reprinted as an insert to Bulletin No. 11.
4. "Apuntes para el Mejor Conocimiento, Clasificación y Valoración de las Principales Especies Arboreo—Forestales de Filipinas," por Emilio Maffei Puigdullés, Manila, 1895.
5. "Felling, Sawing, and Seasoning Timber," by the present writer, published in "The Philippine Craftsman," March, 1913.
6. "A Manual of Indian Timbers," by J. S. Gamble, M. A., C. I. E., F. R. S., F. L. S., new and revised edition, London, 1902.
7. "Identification of the Economic Woods of the United States," by Samuel J. Record, M. A., M. F., first edition, New York and London, 1912.
8. "The Mechanical Properties of Woods," by the same author, New York and London, 1914.
9. "Lumber and Its Uses," by R. S. Kellogg, Chicago, 1914.
10. "The Principal Species of Wood: Their Characteristic Properties," by Charles Henry Snow, C. E., Sc. D., first edition, New York and London, 1903.
11. "The Preservation of Structural Timber," by Howard F. Weiss, New York and London, 1915.
12. "Wood Preservation in the United States," by W. F. Sherfesee, Bulletin No. 78 of the U. S. Forest Service, Washington, 1909.
13. "Wood Finishing," by F. W. Cheney, in the "The Philippine Craftsman," February, 1913.

Beside these works, information regarding distribution, local names, and sizes of trees was obtained from various botanical publications in the Philippine Journal of Science and many statements regarding structure, mechanical properties, and methods of conversion and seasoning from various publications of the United States Forest Service.

The author wishes also to acknowledge his indebtedness to Mr. E. D. Merrill, botanist, Bureau of Science, for verifying the scientific names;

to Dr. F. W. Foxworthy and many other colleagues for help in the preparation of the manuscript; to Mr. T. C. Zchokke, forester, for help in reading the proofs and preparing the indexes; and especially to his two assistants, Rangers L. J. Reyes and J. M. Pascual, for the greater part of the labor of collating the data regarding distribution and local names.

The great bulk of the local names of the trees in different regions as cited in the descriptions have been taken from the labels of botanical collections. In addition to these, there are included many local names given on good authority with commercial lumber, or with wood specimens collected by forest officers without botanical material. A few words as to the spelling and pronunciation of the names would not be out of place. As far as it was possible to ascertain the pronunciation of the names, by consulting with Filipino rangers and other employees of the Bureau of Forestry from many different provinces, this has been represented by a strictly phonetic and uniform spelling, except in the case of names that have acquired a definite standing as trade names and those that are listed in the four groups designated in the Forest Manual. The five vowels have ordinarily the Latin or "continental" value; practically the only exception to this is in the termination *en* common in northwestern Luzon, in which *e* has a sound resembling German *ö*, or *u* in English *sun*. *Au* equals *ou* in *cloud; oi* as in *coin;* and *ui* as *uey* in *gluey*. The consonants *b, d, f, h, j, k, l, m, n, p, r, s, t, v, w, z* have the same value as in English. *C* is used, with the exception of a few words in which the Spanish spelling is retained, only in the combination *ch,* sounded as in *church*. *G* is always hard as in *get*, never equal to Spanish *j* or to English *g* in *gin*. *Ng* (n͠g) as in *singer*. *Ngg* (n͠gg) as *ng* in *finger*.

Only two marks are used to indicate pronunciation—the accent, wherever it has been possible to ascertain the true accentuation of the name; and the apostrophe, which indicates a sound called the glottal check or throat stop, a sound not represented by any letter in European alphabets, but well known in the common American colloquialism of *ye'* for *yes*.

There has been in past usage no attempt at any uniform spelling. Both Spanish and American authors have been very careless about reproducing the native names of the trees exactly, and, moreover, neither the Spanish nor the English orthography is fitted to represent accurately all the sounds of the Philippine languages. It was therefore thought advisable, in the interest of uniformity and consistency, to reduce to the above outlined system of spelling all the names cited, with the exceptions above noted. There is the more justification for this in the fact that not even all the English publications of the American régime are uniform, to say nothing of the conflicts between these and the earlier Spanish authors.

All prices in this bulletin are stated in Philippine currency; ₱1 (one peso)=100 centavos=$0.50 U. S. currency.

E. E. S.

COMMERCIAL WOODS OF THE PHILIPPINES.

PART I.—FORESTS, TIMBER SUPPLY, MARKETS.

EXTENT AND DISTRIBUTION OF FORESTS.

The virgin forests of the Philippines cover some 40,000 square miles (considerably more than 100,000 square kilometers). In addition to these, there are about 20,000 square miles of more or less scattering, cut-over, and second-growth forests, part of which furnishes a present supply of timber and firewood for local use and part will grow up to increase the future supply of commercial timber. The commercial forests are found in Luzon, Mindoro, Samar, Leyte, Negros, Mindanao, Palawan, and numerous small islands; in fact, in all the principal islands of the Archipelago, except Bohol and Cebu.

ACCESSIBILITY.

The territory is often rough, but no more so, and generally less, than in some of the greatest lumbering regions of North America. There are few large watercourses, but no point anywhere, even in the largest islands, is more than 50 or 75 miles from tidewater and the character of the country is rarely such as to present insuperable obstacles to the construction of railways.

COMPOSITION AND DENSITY.

Though the composition of the forests, from the botanist's point of view, is very complex, it is less so from the point of view of the forester, and still less from that of the lumberman. About three-fourths of the total volume of the virgin forest is composed principally of trees of the dipterocarp or lauan family, which furnish all of the very abundant export timbers of the Islands. In these forests, which contain stands ranging from 10,000 up to 50,000 feet B. M. per acre, 75 to 90 per cent of the total bulk belongs to a group of different botanical species that enter the market under about half a dozen trade names.

LICENSES AND FOREST CHARGES.

The Government owns more than 99 per cent of all standing timber in the Philippines. Licenses and concessions for the extraction of lumber and minor forest products are obtainable on easy terms. The title to the land remains in the Government, the forest charges being paid progressively as the timber is extracted. The charges are low, being only about ₱10 per 1,000 feet B. M. for the highest grade woods, such as narra and ebony of the first group, and about ₱6, ₱4, and ₱2 respectively, for woods of the second, third, and fourth groups. The great bulk of the export timbers are of the comparatively light and soft and very abundant species belonging to the third and fourth groups.

LUMBERING METHODS AND LABOR.

The methods of lumbering in pre-American days were very primitive. Lumbering on a large scale was unknown. Individual trees were selected, felled, stripped of bark and sapwood, or else squared, and the resulting

poles or logs hauled out with teams of carabao (water buffalo). The hauling was done on crude carts or timber wheels, sledges or, perhaps in a majority of cases, by dragging the log over the ground with no more apparatus than an occasional skid or roller. The smaller operators still use these methods with very few improvements. Logging engines and railroads have been introduced only in the past ten years by a few of the largest operators. At present, boss loggers, superintendents of logging railways, sawyers and saw filers, and yard bosses are generally Americans. Track layers, locomotive and stationary engineers, fellers, skidders and loaders, setters, operators of edgers, trimmers, resaws, planers, and matchers are all Filipinos, and they are beginning to learn such trades as sawing and saw filing and otherwise to fit themselves for the more exacting positions.

TRANSPORTATION.

Steamers specially fitted for carrying lumber are few and freight rates high. Large operators should own their transportation from the mill to Manila or to other points within the Islands and export stock should be shipped direct from the mill in ocean-going steamers to prevent the additional expenses of transshipping at Manila.

COST OF OPERATIONS.

The cost of operation will be lower than in most lumbering regions of the Temperate Zone, or other forest regions of the tropics. The forest charges (stumpage), as has been remarked above, are low, especially when the quality and selling price of the woods are taken into consideration. Logging and sawmill machinery, if imported from the United States, comes in free of duty. From other countries the import duty is only 15 per cent. Labor is cheap; common laborers can be gotten for ₱0.50 to ₱1.50 per day (the average being nearer the lower than the higher rate), while skilled artisans get one-half, or less than one-half, the pay of imported European or American workmen. Sawmill waste almost always supplies more than enough fuel. The question of water supply must be carefully considered before locating a mill, as water is not to be found in abundance everywhere. The problem is, however, generally easily solved if this matter is given proper consideration in selecting a mill site. Logging locomotives burn principally wood, with a small admixture of coal. Coal of fair quality cost about ₱12 per ton in Manila.

MARKETS.

The following table shows the growth of the export trade in Philippine lumber during the past nine and one-half years:

Fiscal year—	Quantity.	Value.
	Board feet.	
1906-7	252,000	₱10,072.00
1907-8	925,000	------------
1908-9	694,000	------------
1909-10	1,376,000	------------
1910-11	1,677,750	142,802.00
1911-12	1,096,560	143,588.00
1912-13	4,518,144	448,954.00
July to December, 1913	4,281,552	342,266.00
1914	8,509,632	681,272.00
1915	11,745,312	979,636.00

By far the greater part of all of the lumber so far produced is consumed in the Islands, only a very low percentage of the total output being exported. Moreover, considerable amounts of timber have been imported, principally railroad ties from Australia and redwood and Oregon pine (Douglas fir) construction timber from the United States. For some years past such imports have been steadily decreasing with the growth of the local lumber industry. As the latter develops, a growing market for export lumber will undoubtedly be developed in the United States, where Philippine woods are already favorably known in certain industries. On the Pacific coast, considerable quantities of tanguile, red lauan, lumbayao, and almon have already been used for inside finish in both office buildings and residences, as well as for both solid and veneered doors and for furniture. The China market presents a promising field, where Philippine hardwoods find little difficulty in competing successfully with Oregon pine and with hardwoods from other countries. For ease of working, as well as for beauty of finish, they have been highly praised by manufacturers, architects, and others. Apitong has been used as flooring and given perfect satisfaction, while yacal, though it has not been used commercially, is sure to prove, on account of its density and hardness, a superior material, on one hand, for skating rink and ballroom floors, where a hard, smooth surface is required, and, on the other, for factory floors, where a high degree of resistance to rough usage is demanded. For the highest grade of interior finish and furniture such woods as acle, narra, tindalo and banuyo have been introduced; these rank high among the cabinet woods of the Tropics and, once seen in a well-finished job, need no further recommendation. Though these, on account of their relative scarcity as compared with woods of the lauan family, will never form as important an element of the export trade from the Islands as do the latter, their unexcelled beauty of grain and color will always assure them a place for the finest grade of work.

In the Eastern States, also, tanguile and the lauans, as well as some of the less abundant woods, have already acquired a good reputation, and this not only on the coast, but far in the interior; about the end of 1913 one firm at Grand Rapids, Michigan, purchased from New York 400,000 feet of red lauan in a single order, while in and about New York this wood has been put to all the uses, in finishing and ornament, of quartered oak and the South American mahoganies. A former governor-general of the Islands took back to the United States thousands of board feet of Philippine woods for the interior finish of his residence, because he was convinced he could find nothing more beautiful among either native or imported woods in the States.

To Europe, China, India, and other countries of the Orient there have been shipped only smaller quantities of woods for interior finish; but, on the other hand, China has in past times taken from the Islands considerable quantities of durable woods for ship and wharf building, such as aranga, yacal, dungon, and molave. This trade was badly interrupted, first by the wars in the Islands, beginning with the revolution of 1896, and afterwards by unsettled conditions in China, but seems in a fair way to be revived now and to assume greater proportions than before. The mausoleum of the late Emperor of China was constructed almost entirely of two Philippine woods—pagatpat and narra, which latter is practically identical with the padauk of India. A great deal of medium-grade and cheap furniture is made in Manila of white lauan stained in imitation of

other woods, and there is no doubt that it would find a large field for similar work in China and other oriental countries.

India has in recent years purchased railway ties and railway-car timber, mostly of apitong, from the Philippines. As this is one of the most abundant woods in the Islands, it is expected that this trade will increase with those provinces of India where timber is not abundant and where apitong and similar woods give good results.

Europe, on account of the great distance and high freight rates, has taken only comparatively small quantities, as a rule of the finest cabinet woods. Since the American occupation this trade has increased somewhat. Especially the development of the modern veneer industry, for which high freight rates on the raw material are not so great a disadvantage, gave promise of demanding greater quantities of logs before the beginning of the war, and will probably revive on a greater scale than before as soon as the war is over.

In America and Europe, especially the former, there can be no doubt that the use of Philippine woods will grow rapidly for all such uses as house and office furniture, bank and office fixtures, and general interior finish. The nearer markets, on the other hand, China, India, perhaps Australia, and various other oriental countries, are more likely to call for strong and durable construction timbers and for large quantities of the cheap and plentiful woods used for the most ordinary light construction.

Beside all the above general categories, it is quite certain, from the very great variety of woods found in the Islands, that certain species, on account of their hardness, toughness, durability, or other qualities, will in time be found to supply very definite wants in various special industries.

PRICES.

One of the most difficult matters in any discussion concerning timber is to give a just estimate of prices. The price of a given wood, even when lumber of the same dimensions and quality is in question, may vary in accord with many external conditions. Broadly speaking, as in every other business, supply and demand are the chief governing factors in the long run. Periods of activity or depression in the business world in general have their influence on supply and demand. When, in addition to these general conditions, it is remembered that the same wood varies in price greatly according to the dimensions and quality (or "grade," to use the technical term of the lumber trade), it will be seen that any price that is not a quotation for a given class of lumber, for a specific time and place, can only be a broad approximation. The prices cited for the various woods in Part V are such approximations, the maximum and minimum being taken from a great many miscellaneous sources from transactions that date from the years 1900 to 1915. The lowest prices quoted are, in many cases, the prices of mill-run lumber, excluding, of course, slabs and culls, at the mills in Manila or in the Provinces, while the highest prices quoted are for selected lots of lumber of high grade or special dimensions, etc.

These prices are included only for the purpose of giving a very general idea as to what these woods have sold for in the past and should by no means be used as a guide by the prospective purchaser as to what he will have to pay for these woods at present. The fact that the qualities of many of the woods are not yet well known makes a definite statement as to prices unsafe, as the price of any particular wood is liable to increase

or decrease considerably as its uses or suitability become better known, or the supply becomes greater or less.

It must also be borne in mind that these general prices apply to local use and do not apply to exported lumber. The natural factors of export must be considered by the foreign buyer and taken into consideration when looking over these figures. Such factors are freight, grade, seasoned material, etc.

The Bureau of Forestry at Manila, P. I., keeps on hand at all times a list of all the present lumber manufacturing exporters or those in a position to export and it is advised that any one interested in purchasing Philippine woods write to the Director of Forestry, stating his requirements. In this way the prospective buyer will be put in direct touch with all exporting firms and can get definite prices on all classes of material of whatever species he wishes to buy.

GRADING RULES.

To enable one not familiar with Philippine conditions to understand both the entire absence of anything like grading rules up to very recent times and the difficulties of establishing such rules for the local and foreign markets, it is necessary to call attention to the salient points of the lumber business in the Islands.

In the first place, there existed during the Spanish régime, and no doubt centuries before that, a lumber industry which, though extensive, was distributed among a large number of small operators, Filipinos and Chinese, each of whom did, so to speak, a hand-to-mouth business over a very limited area. More than this, the individual who desired to build a house often employed his own men to fell, haul, and saw up his lumber, years often passing before he began to build.[1]

To a small extent, logs of fancy cabinet woods and ship timbers had already been obtained by Chinese merchants for export to China before the Spanish conquest. During the Spanish régime, a few small water and steam power mills were built, but they followed to a great extent the old system of buying logs and sawing them only to order. Two or three steam mills in Manila, the largest in the Islands, founded between ten and twenty years before the American occupation, carried some stock of sawn and even milled lumber, but their stock of logs was always very much greater than that of lumber. The exportation of logs to China was also greater than in pre-Spanish times, and occasional small shipments of cabinet woods were made to Europe. Add to all these circumstances the fact that even a small hand-power shop might have in stock logs of several score different kinds and it is easily seen that under such conditions grading rules were neither necessary nor even possible. Every sale of lumber was an individual bargain, kind and quality of lumber, as well as prices, varying with an infinity of local conditions. It was only some time after the establishment (about the middle of the past decade) of large mills operating in the heavy dipterocarp forests, that there began to be put on the market large quantities of sawn lumber of a few abundant species, such as red and white lauan, apitong, palosapis, guijo, and yacal.

The present situation is this: There are three fairly distinct classes of operators—(1) the numerous hand-power shops, sawing a number of

[1] The writer knows of one large house in a provincial capital, the owner of which gathered and stored lumber for sixteen years before beginning construction. This is by no means an exceptional, but rather a typical, case.

different woods, generally to order, and carrying no considerable stock of sawn lumber; (2) the small water or steam power mills, working along much the same lines, but carrying a stock of some thousands or tens of thousands of feet of rough and milled lumber; and (3) a few large mills, producing and carrying large stocks of a comparatively few species. Shops of the first class are entirely in the hands of Filipinos and Chinese, mostly with very little capital; those of the second class are run by Spaniards, Filipinos, and Chinese, with a sprinkling of European or American operatives of the higher grades; while the large mills are founded almost entirely by American or European capital and managed by Americans; one large mill is owned and operated by Spaniards; one (more recently started) by Chinese; and one by Filipinos and Spaniards. Early in 1913, a lumbermen's association was founded by representatives of all these elements in Manila, but it did not get so far as seriously to consider the adoption of uniform grading rules, to say nothing of an attempt actually to formulate them. A more recent and more promising attempt has been made by the formation of the Philippine Lumber Manufacturers Association organized in 1915.

In 1910, the Government of the Philippines found it desirable to establish a lumber depot of its own in order to be able promptly to supply seasoned lumber for public projects, such as bridges, municipal and provincial government buildings, markets, and schoolhouses, etc. Both in purchasing lumber and in supplying requisitions, the absence of any fixed standard of quality was a serious inconvenience. Finally, in 1913, officials of the Bureaus of Supply and Forestry decided to draw up a set of rules to govern the business at least of the former Bureau. Such a set of rules, based in their main outlines on the rules of the lumbermen's associations of the United States, but in details adapted to local conditions and to the different character of the woods, was drawn up and submitted tentatively to lumbermen, Government departments interested in the use of woods, etc. It was in no way intended that these rules should be forced upon the lumber industry for any private business. At the same time it was proposed that they should be adopted for all Government purposes. While this latter intention has not so far been put into effect by any formal enactment, the Bureau of Supply has largely followed the rules both in purchases and in sales to other departments.

In 1914, the lumbermen of the Province of Zamboanga (where there is a larger number of mills than in any other one province) formed an organization, and early in 1915 they adopted, with slight modifications, the above-mentioned rules.

The essential portions of the text of the rules are given in Appendix No. 3.

One of the first acts of the newly organized Philippine Lumber Manufacturers Association, referred to above, was to appoint a committee on grading rules. In fact, the formulation and general adoption of uniform grading rules is cited as one of the principal objects of the establishment of the association. At this writing, the committee has not had time to submit definite rules for the approval of the association.

Part II.—PROPERTIES OF WOOD; METHODS OF CONVERSION; WORKING AND FINISHING; PRESERVATIVE TREATMENT.

PROPERTIES OF WOOD.

To understand the difficulties encountered in converting the trunk of a tree into products that shall be serviceable and of pleasing appearance, it is necessary to know something of the phenomena that take place during the processes of cutting, drying, and otherwise preparing the raw material; and to understand the causes of the varied behavior of wood during these processes, the user must be acquainted with the structure of wood and its most essential qualities.

SOFTWOODS, HARDWOODS, PALMS, ETC.

The woods of coniferous trees (the pine family, or "softwoods")[1] are nonporous, generally very straight-grained and of fine and even texture, except for certain species that have very distinct alternate bands of softer and harder wood in each growth ring. Those of broadleaf trees (deciduous, or "hardwoods") are porous, frequently more or less cross-grained, in every way of more complex structure and much more variable in color and texture than the conifers. Palms, which do not increase in diameter by adding successive layers of wood to the outside of the trunk, but start up from youth of full diameter size and grow only at the tip, have a thin outer shell of frequently very hard and heavy wood showing no rings at all and a large, pithy core. Rattans, which are the climbing members of the palm family, are of similar structure, but have a proportionately thinner outer shell and are much more flexible than the rigid erect palms. Bamboos are giant grasses, having hollow jointed stems, with walls ranging from less than one-eighth to more than 1 inch in thickness. The wood of the walls is fairly uniform except for having a very thin and extremely hard outer skin.

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[1] The use of the words "hardwood" and "softwood" in a special sense has become so universal in English that it cannot be avoided. The hardwoods are understood to be all those of the broadleaf trees, the softwoods, of the needleleaf trees. No other more satisfactory terms are available. Though broadly speaking, the distinction is not incorrect, for the latter are really, on the average, lighter and softer than the former, yet the range of variation within each of the two classes is so great that they overlap widely, and the hardest and heaviest among the "softwoods" are considerably harder than the softest and lightest among the "hardwoods." The average specific gravity of 26 North American softwoods is 0.39, that of 47 hardwoods 0.53, but over three-fourths of the former have a higher weight than the lightest of the latter. Longleaf pine has a specific gravity of 0.53, yellow buckeye and black willow only 0.33.

Other descriptive terms do not fit in all cases. Some of the pine family or "coniferous" trees do not bear cones, nor does "needleleaf" satisfy all cases, for some species of the family have quite broad, flat leaves.

In the Philippines, as in most other tropical countries, these terms are not only less applicable to the true conditions than in North America, but there is little occasion for their use. With the exception of two species of pine (*Pinus insularis* and *P. merkusii*), almaciga (*Agathis alba*, of the same family), and a few species of the yew family, all Philippine timber trees are of the "hardwood," or broadleaf class. Their range of hardness is even greater than that of American softwoods and hardwoods combined. The terms "hardwood" and "softwood" will, therefore, rarely be used in this work, but rather wood that is hard will be described as "a hard wood" or one that is soft as "a soft wood," regardless of scientific or commercial classifications.

STRUCTURE OF WOOD.

The palms, rattans, and bamboos do not furnish lumber in the ordinary sense of that word. The following discussions of structural and mechanical properties, therefore, refer only to those woods that furnish saw timber—that is, the conifers and broadleaf trees.

Wood is made up principally of very numerous minute fibers and other elongated elements lying, broadly speaking, parallel to the axis of the tree. These constitute the chief bulk of the wood, and their thickness, arrangement, color, etc., determine the general appearance of the grain and texture of the wood, except insofar as it is also influenced by the pith rays. These are very thin, flat bundles of cells lying at right angles to the axis, passing radially from pith to bark between the vertical fibers. They are generally much higher—that is, "wider" as seen on the face of a radial section—than they are thick. Pith rays are not generally conspicuous except in a radial, or nearly radial, section, where they form the familiar "flake" or "silver" grain so well known in quarter-sawn oak. In a tangential section—that is, parallel or nearly so to the growth rings and therefor at right angles to the rays—they appear as short, narrow lines, or mere elongated dots, parallel to the grain. In woods having very numerous pith rays, these may form as much as one-fourth of the total bulk, but in most species they amount to less than this. The large rays in oak represent only about one-hundredth of the total number, the smaller ones being hardly or not at all visible to the naked eye. Pith rays are most numerous in the conifers; over 15,000 have been counted in 1 square inch of a tangential section of pine.[1]

Microscopic study shows that there are several different kinds of fibers. Descriptions of their most conspicuous differences will be found in Part IV, "Methods of identification." It is sufficient to state here that they are all hollow, that the walls are saturated with water, that water also forms over 90 per cent of the contents of the living cells in the young wood and more or less completely fills the lifeless cells in the heartwood. It should be understood wherever water is mentioned as being present in wood, that a thin watery solution is meant, containing various organic and inorganic substances.

DENSITY.

The varying weights of different woods when dry do not depend on the quality of the wood substance itself, but on the relative thickness of the cell walls and size of the cell cavities and pores. The weight of the wood substance is nearly the same in all species, being about 1.5 to 1.6 times the weight of water. If a dry piece of wood of any species could be subjected to a pressure sufficient to squeeze all the air out of it, compacting it into an absolutely solid mass, it would then have a weight of nearly 100 pounds per cubic foot. Light woods float only because of the relatively large amount of air contained in the various wood elements.

HEARTWOOD AND SAPWOOD.

All coniferous and broadleaf trees grow in diameter by adding successive layers of wood to the outside of the trunk, just within the bark. This young wood is less dense and contains a greater amount of sap (water carrying the nourishing substances of the tree), and the walls of the cells are thinner, than is the case with the more mature wood, in which the processes of

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[1] "Timber," by Filibert Roth, Bull. 10, U. S. Dept. of Agr., Division of Forestry, Washington, 1895.

thickening of cell walls and of deposition of various mineral substances have contributed to produce the ultimate dense, hard, deeply colored "heartwood" which we commonly consider as typical of the species. The wood of very young trees is generally light colored and porous. In some trees, the color changes little or not at all as the tree grows older, as for instance in lanete (*Wrightia* spp.). Of such trees we say that they have no distinct heartwood and sapwood. In the great majority of trees, however, there begins at a certain age the formation of heartwood, which is caused by the infiltration of various substances, such as oils, resins, pigments, mineral substances, into the cell walls and, in some cases, also into the cell cavities and pores. This process begins over a more or less large area about the center and, once well started, keeps about even pace with the growth of the tree, so that the surrounding layer of sapwood forms a belt of nearly the same thickness during future stages of growth. In young trees of rapid growth, the formation of heartwood is slower and the thickness of the sapwood consequently greater; in old trees, the formation of heartwood is proportionately more rapid while the growth of new wood is much slower and the belt of sapwood is consequently proportionately thinner. The heartwood, as a general rule, is darker, heavier, harder, and stiffer (but sometimes more brittle) than the sapwood. In trees possessing a special odor, white or colored deposits in the pores, or other peculiarities, all such qualities are, as a rule, more pronounced in the heartwood. Also, it is generally more durable as regards both fungus and insect attacks. In trees having no distinction of color between sapwood and heartwood, there is generally little difference between these in strength and durability; where the coloring of the heartwood merges gradually into that of the sapwood, the difference in quality is not great; but in those species where there is a sharp line of demarcation between dark heartwood and light sapwood, the latter is generally very much inferior to the former, especially as regards resistance to decay and insect attacks.

In certain tropical woods there is a further distinction which, though not common nor of much importance as regards the appearance of the wood, is yet probably of some influence as regards durability. It is often observed, especially in species having a very dark heartwood, that there is first a narrow belt of sapwood, followed by a more or less broad belt of uncolored heartwood, which in turn incloses a core of colored heartwood. This is especially notable in camagon and the other species of the genus *Diospyros*. It seems that the processes involved in the thickening and hardening of the cell walls during the conversion from sapwood to heartwood do not always bring with them at once the deposition of coloring matter, but that this latter takes place only some considerable time after the formation of the heartwood. There is in such woods very little difference between the true sapwood and the uncolored heartwood (except that the former seems, in some cases, to be more liable to become discolored in drying) so that they are generally classed together as sapwood. It is probable, however, reasoning from the general differences between heartwood and sapwood, that this uncolored heartwood would be somewhat more durable that the sapwood, though it may not be as good in this respect as the denser colored heartwood, impregnated as the latter is with preservatives injected by natural processes. This seems to be confirmed by the fact that wood specimens from very young trees are often completely riddled by beetles, while specimens of the same species from trees much larger, yet containing no colored heartwood, are attacked either not at all or only in their outermost portion—that is, the true sapwood.

DOTY HEART.

All the foregoing statements about heartwood and sapwood are only broad general rules. There are exceptions to all of them. One notable exception is so common that it needs mention here; it is often found that the inner portion of the heartwood of large trees is distinctly softer than the outer, younger part; this is common, for instance, in woods of such widely different characteristics as red lauan and molave. It is due to the fact that, when young, many trees grow very rapidly, producing large and thin-walled cells which form light and soft wood, while later they grow more slowly, consequently forming much denser wood. In such trees, when fungi and insects gain access to the interior through wounds in the bark, rotten knots, fire scars, etc., they naturally penetrate the soft inner wood more rapidly than the hard shell that surrounds it. This is one of the commonest causes of worm-eaten and "brash," "punky," or "doty" heart in overmature trees. However, when not attacked by insects or disease, there is no difference to be observed except in the degree of density and hardness, as well as sometimes a slight difference of color. Such soft, but perfectly sound, heartwood is frequently found, for instance, in dita.

GROWTH RINGS; STRAIGHT AND CROSS GRAIN.

The successive layers of growth have considerable influence both on the appearance and behavior of wood. Where the fibers in all layers are parallel to the axis of the trunk, the wood is "straight grained" and is generally easy to split and to plane either parallel to the growth rings or across

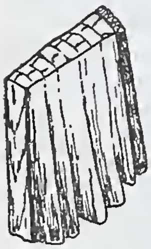

Fig. 1.

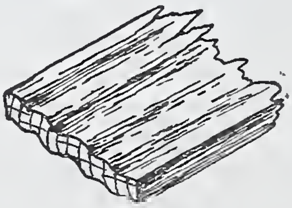

Fig. 2.

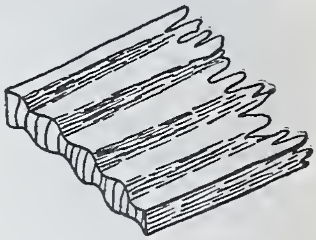

Fig. 3.

them—that is, in tangential or radial section. But often the fibers in alternate layers, instead of being parallel, twist spirally around the trunk in opposite directions. Such wood may split quite easily between the rings—that is, tangentially—but across the rings, or radially, it will split in the manner shown in figure 1. As lumber is in most cases not split, but sawn, this is of little importance in the sawmill, but two subsequent difficulties arise from this peculiarity. Boards sawn radially from very cross-grained woods have a tendency to warp in drying in the fashion shown by figure 2,[1] which, in the first place, reduces their effective thickness and causes additional work in surfacing, and, in the second place, makes such pieces difficult to surface for, as the grain runs alternately "up" and "down," planing the wood in either direction leaves a series of alternate rough and smooth strips. Once well surfaced, however, this feature gives the much-admired "ribbon grain."

The growth rings also vary in color, hardness, and density. Generally, where any noticeable differences exist, the inner part of each ring is softer,

[1] It must be understood that both this and fig. 3 are exaggerated both as to the depth and the regularity of the corrugations.

lighter colored, and more porous than the outer part. The difference in hardness and density often causes radially sawn boards to shrink as shown in figure 3, causing the same loss of material as in the previous case, except that, where not also accompanied by cross grain, the surface will not be so difficult to plane.

WATER CONTENT.

As remarked above, the wood cells contain water, both in the walls and in the cavities. Soft, porous woods contain more than hard, dense kinds. Almost without exception, there is more water in the sapwood than in the heartwood. Very few accurate data are available on the moisture content of Philippine woods, but there is probably no great difference in this respect between woods of the Tropic and Temperate Zones. The following extract[1] shows the variation in water content of different kinds, and of sapwood and heartwood of the same kind, among American woods:

Water lost in drying 100 pounds of green wood in the kiln.

	Sapwood.	Heart-wood.
	Pounds.	*Pounds.*
Pines, cedars, etc	45-65	16-25
Poplar, cottonwood, basswood	60-65	40-60
Oak, ash, beech, elm, maple, hickory, chestnut, walnut, sycamore	40-50	30-40

The very low moisture content of the heartwood of pine is due to its being almost completely filled with resin; except Benguet pine (*Pinus insularis*) and Tapulau (*P. merkusii*), there are no Philippine woods that can well be compared with the heavy, resinous "hard pines" of America. With the woods in the second line may be compared such Philippine woods as calantas, white lauan, white nato, etc., and with those in the last line such as tindalo, molave, acle, and others. The highest figure in the table, 65 pounds, is equivalent to a moisture content of 185.7 per cent of the weight of the resulting dry wood; it is probable that some of the softest and most porous Philipppine woods contain even more than this. The lowest figure (excepting the special case of heartwood of pine) amounts to 42.8 per cent; some of the densest Philippine woods, such as mancono and sasalit, very probably contain less.

MECHANICAL PROPERTIES.

The mechanical properties of each wood are closely related to the structural peculiarities of the species, in fact, are directly dependent on them, except insofar as they are influenced by greater or less moisture content. But this relation is not generally evident on superficial examination; careful anatomical study of the structure and exact mechanical tests are required to demostrate it. Moreover, such tests must be made on many pieces, for the mechanical properties of one and the same species vary widely in different regions, in different trees from the same place, and even in different parts of the one tree. The figures published in tables of weights, hardness, strength, etc., must therefore never be taken as being exact measures, but rather as close approximations. The more tests of different specimens such figures are based on, the more nearly will they represent reliable averages. While they cannot safely be applied to single pieces, they do furnish safe guides as to the relative qualities of larger lots of two or more different woods.

[1] From "Timber," by Filibert Roth, U. S. Dept. of Agr., Div. of Forestry, Bull. 10, 1895.

WEIGHT.

The weight of wood is the property which most directly and evidently depends on its structure. Dense woods contain more fibers to a given area, or thicker walled fibers, or both, than do less dense ones—that is, they contain a larger amount of material to a unit of volume and so are heavier. The presence of resin and other deposits in the cavities of the wood elements may also considerably influence the weight.

The following table[1] gives the average weights ("oven dry") of Philippine woods tested in Manila:

Name of wood.	Specific gravity (oven dry).	Name of wood.	Specific gravity (oven dry).
Cupang	0.285	Amugis	0.685
Palosapis [a]	.399	Guijo	.703
Red Lauan [b]	.406	Liusin	.710
Calantas	.443	Macaasim	.716
White lauan	.462	Supa	.762
Almon	.464	Molave	.784
Tanguile	.490	Ipil	.784
Banuyo	.525	Tindalo	.780
Balacat	.548	Betis	.792
Narra	.553	Batitinan	.795
Lumbayao	.565	Agoho	.833
Sacat	.589	Yacal	.843
Acle	.607	Bansalagin	.850
Palo Maria	.623	Dungon [c]	.854
Dao	.631	Aranga	.859
Apitong	.632	Sasalit	.872
Malugay	.658	Alupag	.961
Mangachapuy	.658	Mancono	1.236

[a] This is the wood described by Gardner and Foxworthy as "mayapis," which name is now used for a lauan (*Shorea squamata*). It should be noted that the specific gravity here assigned to it is somewhat low, Gardner's test material having been from comparatively small trees in a lowland hill region, while the palosapis now on the market comes from large trees grown on the lower slopes of mountainous regions and is known to be denser than the test material.

[b] This figure is probably also slightly too low. Most other more recent data indicate that red lauan is heavier than the other lauans (except tanguile) and than calantas. Red lauan should probably lie between almon and tanguile in this table.

[c] The material tested as dungon was of three different lots. The third lot (see footnote, Appendix 2, p. 218) was not true dungon. Though its botanical status has not yet been ascertained, it is certain that it is of a different species and it is known to have a much less dense texture than dungon. The specific gravity here given was, therefore, based on the first two lots only.

In scientific work, weight is generally given as specific gravity—that is, the ratio between the weight of a given volume of wood and the weight of an equal volume of water. For example, if the specific gravity of acle is given as 0.607, this means that a cubic meter of acle weights 607 kilos, which, compared with the weight of a cubic meter of water, or 1,000 kilos, gives the fraction 607/1000, or 0.607. Or, in English weights and measures, it means that the weight of a cubic foot of wood equals 607/1000 of the weight of a cubic foot of water—that is, 0.607×62.5 lbs. $=37.94$ lbs.[2] Owing to the great variability of the moisture content and of the shrinkage of wood, no data as to specific gravity can be safely used for purposes of

[1] Arranged from data of Bulletin No. 4, Bureau of Forestry, P. I., and from unpublished data by Gardner and others.

[2] As 1 cubic meter equals 35.314 cubic feet and 1 kilo equals 2.20462 pounds, hence:

$$\text{wt. per cu. ft. in lbs.} = \frac{\text{wt. per cu. m. in k.} \times 2.20462}{35.314}, \text{ or } \frac{\text{wt. per cu. m. in k.}}{16.018},$$

which for ordinary purposes gives the simple and convenient divisor 16 for converting weight per cubic meter in the metric system to weight per cubic foot in the English system. Also, as the specific gravity is the weight per cubic meter written as a fraction, to obtain the weight in the English system, instead of multiplying the specific gravity by 62.5 we can write the specific gravity as a whole number and divide by 16. In the example above given, the operation would be simply $607 \div 16 = 37.94$ lbs.

exact comparison unless they are based on the volume and weight in the "oven-dry" condition. In commercial operations, the weight of air-dry, or, as it often called, shipping-dry, wood is used and is generally given in tables expressing the weight in pounds per 1,000 board feet. (See Table of shipping weights, Appendix No. 2.)

While great weight is in itself more often an objectionable feature than an advantage, it generally serves as a recommendation for a wood on account of the fact that most of the other and more desirable qualities, such as hardness, strength, toughness, and durability, are more or less intimately related to it.

STRENGTH OF WOOD.

Cross bending.—One of the most conspicuous and valuable properties of wood is that of resistance to breaking when subjected to a bending strain, as is a beam when supported at the ends and itself supporting a load. It is this property which fits wood to be used in construction in the form of long beams where stone cannot be used on account of its brittleness, nor steel on account of its great weight and cost. The strength of a beam is directly proportional to its breadth—that is, length and depth being equal, a beam twice as wide as another is twice as strong. It is directly proportional to the square of the depth—that is, a beam twice as deep as another is four times as strong. It is inversely proportional to the length (or span between supports), a beam twice as long as another being one-half as strong.

In tests made by timber engineers, the breaking strength of beams is expressed by a fixed formula from the dimensions of the beam (span, depth, and width) and the breaking load. The breaking strength of 34 Philippine woods under varying moisture conditions is given in Appendix 2, Table I, column "Modulus of rupture."

Crushing parallel to grain.—This is the stress to which wood is subject in pillars, struts, etc. In very short, thick pieces with the load or pressure acting squarely on the ends, the resulting strains are very simple and act equally on every unit of area in the cross section of the piece. In such cases, the resistance of the wood to crushing is very closely related to hardness. If loaded to the breaking point, the fibers ultimately yield either by buckling clear across the area of the cross section, or by splitting in one or more nearly longitudinal planes. In case of long columns, the piece yields as a whole in the direction of its least stiffness, becoming concave on one side and convex on the other, and finally fails much in the same way as a beam under a transverse strain. In such cases, the ultimate strength of the column depends more on the stiffness and toughness of the wood than on its hardness. The figures in Appendix 2, Table II, are the results of tests on short, thick pieces (3½ by 3½ by 8 inches and 4 by 4 by 8 inches).

Crushing across the grain.—When a block of wood is compressed between two surfaces of area equal to or larger than its own, the grain being parallel to the crushing surfaces, the stress to which it is subjected is simple crushing and the resistance of the wood to it will be very closely related to its hardness. In practice, it is much more common to find a condition where the pressure acts only on part of the surface of the wood, as where a rail rests on a tie, or the foot of a post on a horizontal structural part. In such cases, part of the pressure exerted goes to compress the area immediately subject to pressure and part to overcome the resistance to bending and shearing of the fibers adjacent to the edges of the area of compression. In addition to hardness, the toughness and stiffness of the wood also influence the results in such a case. Over large areas and for small degrees of compression (about 0.1 inch), the resistance to compression

is generally considerably greater than that to shearing and bending along the edge. On small areas, or when the load is sufficient to cause deeper compression, the shearing strain often becomes much more important than the compressive strain.

The following data are tabulated from stress sheets for 11 different woods tested by Gardner, the loads corresponding to a compression of 0.1 inch.[1]

Strength of 11 Philippine woods in compression across the grain.

Name of wood.	Tests.	Average moisture.	Average specific gravity (oven dry).	Compression of surface (per sq. inch).	Shear along edges (per linear inch).
		Per cent.		*Pounds.*	*Pounds.*
White lauan	18	35.5	0.441	645	460
Apitong	23	36.0	.632	730	650
Tanguile	7	36.7	.531	800	330
Amugis	10	15.9	.681	1,100	700
Guijo	8	35.4	.692	1,250	900
Ipil	6	43.6	.755	1,920	1,000
Supa	5	27.1	.716	2,050	1,200
Dungon	9	25–35	(a)	2,100	1,275
Aranga	8	25.6	.806	2,100	1,850
Yacal	10	28.6	.850	2,275	1,900
Molave	24	42.1	.760	2,300	925

[a] Not determined.

Shear along grain.—Shearing along the grain takes place when a tenon forces out the material at the edge of a mortise situated close to the end of a piece, also when a loaded beam bends and, owing to compression at the top and tension at the botton, splits horizontally. Conifers, owing to their homogeneous structure and straight grain, shear off more easily than broadleaf woods and there is little difference between radial and tangential planes in resistance to shearing. The hardwoods, as a rule, shear with more difficulty in the tangential plane. In case of species having a pronounced alternating spiral, or crossed, grain, the condition is reversed, such woods shearing more easily in the tangential plane—that is, parallel to the growth rings.[2] Results of tests of Philippine woods in shearing along the grain will be found in Appendix 2, Table III. It should be remarked that these tests were made without regard to the direction of the planes of cleavage, but as most of the woods are of very homogeneous structure, having no distinct growth rings, this is of less importance than in the case of many American woods.

[1] Mechanical Tests, etc., of Thirty-four Philippine Woods, by R. Gardner, Bulletin No. 4, Bureau of Forestry.

[2] These statements apply to wood in general, but it is possible that in one respect they may have to be modified when a greater number of tropical woods have been studied and tested. As has been mentioned before, cross or spiral grain seems to be more common and more pronounced in tropical than in northern woods. This so much affects the shearing and splitting strength that it is quite probable that the average tropical wood will shear and split fully as easily and even more easily in a tangential than in a radial plane. Splitting tests made by R. S. Troup, Indian Forest Service, in 1909, point strongly this way. He says: "* * * of the 61 woods tested, the splitting was easier along the tangential plane in 43 woods, and easier along the radial plane in 11 woods, while in the remaining 7 woods the splitting force was identical in each plane. * * * Finally, if we take the average splitting force for all the 61 woods, we find it to be 7.79 for radial and 2.92 for tangential splitting. * * *"

It should be remarked that the woods tested by Mr. Troup were of a character altogether similar to that of Philippine woods, about a dozen being identical with and the majority of the rest closely related to Philippine species.

Shear across grain.—Shearing across the grain takes place when two pieces joined by a wooden pin slide over each other, thus cutting off the pin. The handle of an ax or hammer where it enters the eye, tenons where they enter the mortise, and similar parts, are subject to shearing strains, but in these there are generally present also bending and twisting strains. Shear across the grain is so closely dependent on hardness, resistance to transverse compression, and toughness that the fitness of a wood to resist transverse shearing can be closely judged from these qualities. No data exist of tests of this quality in Philippine woods.

Tensile strength.—The tensile strength of wood along the grain is very great; in yellow pine it is about 17,000 pounds per square inch, a little greater than that of cast iron and about one-fifth of that of a high-grade of Bessemer steel; but steel weighs about twelve times as much as this wood, so that, weight for weight, yellow pine has more than twice the tensile strength of steel. In actual construction, wood is hardly ever torn in two by a longitudinal pull, for the fastenings at the ends of a timber almost invariably pull out through shearing or splitting long before the tension is sufficient to overcome the tensile strength of the piece as a whole.

The following table of tensile strengths is taken from hitherto unpublished tests by Gardner. Longleaf pine and hickory have been included as a matter of comparison:

Tensile strength of Philippine woods along the grain.

Kind of wood.	Pounds per square inch.	Kind of wood.	Pounds per square inch.
Calantas	7,940	Calumpit	10,400
Cupang	9,175	Acle	10,720
Balacat	9,330	Macaasim	11,420
Tindalo	10,250	Benguet pine	11,640
Supa	11,800	Yacal	16,670
Nato	12,425	Longleaf pine	17,300
Ipil	12,670	Alupag	17,600
Palosapis	12,980	Betis	20,300
Apitong	12,980	Mangachapuy	20,630
Liusin	14,750	Agoho	21,890
Malacadios	14,800	Hickory	32,000
Sasalit	15,580		

Across the grain, the tensile strength of wood is very low. It is this fact which causes cross grain and knots to constitute a very serious source of weakness in large timber. Especially is this the case when such defects exist in the lower half of a horizontal beam, which is in tension when the beam is loaded.

STIFFNESS.

Next to strength, stiffness is the most valuable property in a beam. Stiffness is directly proportional to the breadth of a beam—that is, a beam twice as broad as another is twice as stiff. It is proportional to the cube of the depth; a beam twice as deep as another is eight times as stiff. It is inversely proportional to the cube of the span; a beam twice as long as another is only one-eighth as stiff. Stiffness is closely related to elasticity, inasmuch as it is constant and measurable only within the limit of elasticity. (See "Resilience and elasticity," p. 26.) The relative stiffness of woods as determined by tests is therefore indicated by the "modulus of elasticity," a figure calculated from the dimensions of the beam under test and the load and deflection at the elastic limit. (See Appendix 2, Table I, "Modulus of elasticity.")

TOUGHNESS AND FLEXIBILITY.

Toughness is a valuable quality easily recognized in working and using woods, but difficult to define and measure exactly. The word "tough" is often applied to woods that are difficult to split; but the terms are not at all synonymous, as a tough but perfectly straight-grained wood may be easier to split than a hard, brittle, and cross-grained one. A brittle wood is one that breaks more or less suddenly and completely soon after deformation beyond the elastic limit, so a tough wood may perhaps be best described as one that resists complete rupture under deformations considerably beyond this point. Accordingly, it is measured in one way as the "work to maximum load," a figure calculated from the point of complete failure of beams in bending tests, expressed in pounds per cubic inch. Another measure of toughness is the resistance to breaking under repeated blows of a hammer which is dropped on a beam from increasing heights; the relative "resistance to impact" is expressed as the height in inches through which a hammer of given weight must drop to cause complete failure or a certain permanent deflection ("set") of the piece. Probably the best measure of toughness is derived from torsion or twisting tests. For torsion tests, a cylindrical specimen with square ends is held in a lathelike machine, of which the headstock revolves, the stationary tailstock containing apparatus for measuring the force exerted to produce complete rupture. Torsion involves transverse and longitudinal shear, transverse compression, and longitudinal tension of the fibers; it therefore is more representative of the complex stresses occuring in actual practice than are other tests designed purposely to measure each one of these separately. No tests have been made of Philippine woods as to toughness. Relatively one to another, some indication of their toughness may be gained from the figures given in Appendix 2, Table I, under the headings of "Modulus of rupture" and "Modulus of elasticity." Taking into account the facts that practically all woods are most plastic and flexible when green and stiffest when dry, that the quality of toughness is therefore best demonstrated when the wood is dry, and that toughness is the ability to be deformed without rupture when loaded beyond the elastic limit, the best indication of this quality that can be derived from these tables is by observing the relative difference between modulus of rupture and modulus of elasticity in the last column, "Moisture under 20 per cent." That is, a wood having a high factor of stiffness (modulus of elasticity) and a low factor of strength (modulus of rupture) will, broadly speaking, be less tough than one with a relatively lower factor of stiffness and higher factor of strength.

RESILIENCE AND ELASTICITY.

Resilience or elasticity is the power of a body, when deformed by any stress, of returning to its former shape when released. No substance is perfectly elastic, but many are practically so up to a certain point, which is called the elastic limit. Up to this limit, equal increases of load will produce equal increases of deformation, but the body will return to its original form when the load is removed; beyond the limit, an additional unit of load will cause more than the proportionate increase of deformation and the body, when the load is removed, will not return completely to its original form. In very hard, brittle, and almost perfectly elastic substances, such as glass, the limit of elasticity almost coincides with the maximum strength—that is, a glass rod, when bent a very little beyond

the elastic limit, snaps off. In flexible, tough substances, such as rattan, the elastic limit is low and the breaking limit very high. No wood is as brittle as glass, though some, within small limits, are equally elastic, and few or none are as tough and flexible as rattan. A given wood may be very hard and tough and yet not elastic or "springy." A thin piece of Dungon, for instance, which is very hard and tough, and heavier than any American wood, can be bent almost like sole leather, but, like leather, it stays bent instead of springing back to its original form.

PLASTICITY.

Plasticity is the opposite of stiffness and of elasticity or resilience. All woods are more or less plastic when deformed beyond the elastic limit—that is, they acquire a permanent set when loaded beyond this point. Heat and moisture increase plasticity greatly. For this reason steaming and boiling are employed in the manufacture of bent-wood furniture, carriage shafts, felloes, boat ribs, pressed imitations of carving, etc. Plasticity is not the exact opposite of hardness, but hard woods are, as a rule, less plastic than soft ones, for the greater amount of material per unit of volume naturally resists deformation, whether by bending, stretching, or compression, more than does the less dense material of softer woods.

HARDNESS.

Hardness is a property that is recognized and roughly compared even more readily than toughness, but equally difficult to measure. It has been defined as resistance to indentation and to abrasion or scratching. The woodworker defines it as resistance to penetration by tools, which really means either or both indentation and scratching, as well as cutting, according to the kind of tool used. Hardness tests have been made by abrasion with sandpaper or sand blasts, by indentation with tools of various forms, and by scratching. The test used by the United States Forest Service consists of measuring the load necessary to imbed a steel ball 0.444 inch in diameter in the surface of the wood to half its diameter, trials being made on end grain and on radial and tangential sections, the average of the three being considered the measure of the hardness. Gardner[1] used the following method:

"Representative samples of the various species were selected, * * * seasoned, and one surface of each carefully smoothed. Across the grain of each smoothed surface a hardened steel point was drawn, with a pressure of 3.3 pounds. The depth of the scratch produced was considered a measure of hardness. On such woods as ebony and bansalagin, the steel point had very little effect, while on California redwood and calantas it made a ragged scratch one thirty-second of an inch or more in depth. * * * California redwood and Oregon pine are placed in the following list to give an idea of the relative hardness of American and Philippine woods:"

Hardness of 30 Philippine woods.

Very hard:	Hard:	Moderately hard:	Soft:
Ebony.	Guijo.	Apitong.	Lumbayao.
Bansalagin.	Tindalo.	Malasantol.	Balacat.
Sasalit.	Yacal.	Banuyo.	Oregon pine.
Liusin.	Molave.	Tanguile.	White lauan.
Betis.	Batitinan.	Sacat.	Palosapis.
Dungon.	Macaasim.	Narra.	Very soft:
Aranga.	Amugis.		Calantas.
	Palo Maria.		California redwood.
	Ipil.		
	Malugay.		
	Supa.		
	Acle.		

[1] Bulletin No. 4, Bureau of Forestry, Manila, 1907.

EFFECTS OF MOISTURE ON MECHANICAL PROPERTIES.

All mechanical properties of wood are strongly influenced by the greater or less moisture content of the wood.[1] In fact, it influences the strength of timber more than does any structural peculiarity, excepting only decided imperfections, such as large or numerous cracks, bad knots, etc. That the presence of moisture in wood will increase its weight is self-evident. That wet wood is softer, more flexible, and less resilient than dry wood is a matter of common observation. Beside this, mechanical tests show that wet wood is weaker in bending, crushing, and shearing tests. Only in tension tests is the strength very little affected by the moisture content.

All of these statements refer to the natural water content of the wood. Air-dry wood may reabsorb moisture from the atmosphere or may even be soaked until it contains as much water as in the green condition, without becoming weaker than it was when green. Kiln-dry wood, on the other hand, and wood that has been steamed, on being resoaked will become even weaker than in the natural green condition. The higher the temperature at which it has been dried, or the greater the steam pressure to which it has been subjected, the more serious is this effect. Where strength is of more importance than freedom from shrinking, as in structural timbers, wood should therefore be kiln-dried only to a point where the moisture content will correspond to that of the thoroughly air-dry condition, nor should it be subjected to steam at high pressures.

DRYING.

Wood begins to lose water as soon as the tree is felled, or girdled.[2] The first to evaporate is the free water contained in the cells and pores, which is by far the largest part. When this is gone, the water that saturates the cell walls begins to evaporate. Tests of throughly air-dry timber, both in America and in the Philippines, show that it still contains from 7 to 15 per cent of moisture, the average being between 11 and 12 per cent. If air-dry lumber is heated in an oven to the boiling point of water and weighed daily until no further loss of weight is observed, it is called "oven-dry".[3] If then again exposed to the air, oven-dry lumber reabsorbs a certain amount of moisture, but not quite as much as it contained in the air dry state.

Experiments made by the United States Forest Service[4] show that the "fiber saturation point"—that is, the point at which the free water in the cell cavities and pores is completely evaporated and the evaporation of the water saturating the cell walls begins—corresponds to a moisture

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[1] For amount and distribution of water in wood, see p. 21.

[2] When a tree is girdled, the loss of water is very rapid at first, as the leaves continue to draw moisture from the trunk and to evaporate it until they die and fall off. The same effect is obtained by leaving the trees intact for some days or weeks after felling, instead of trimming them at once. Lumbermen in America, who have had trouble with logs sinking in the rivers where they were carried from forest to mill, have found that by this method the proportion of "sinkers" was very much decreased or even reduced to nothing.

It should be noted here that tropical trees are not always easily killed by girdling, for various species have the faculty of completely healing a girdling wound, unless tbe bark and wood are cut away to an unusual width and depth.

[3] This is the condition aimed at in scientific tests and on which are based the values of the specific weights of "dry wood" obtained from such tests. Speaking absolutely, there is no such thing as dry wood, for, if heated above the boiling point, more moisture is gradually given off and finally chemical destruction begins before all the water is driven out.

[4] Effect of Moisture upon the Strength and Stiffness of Wood, by H. D. Tiemann, U. S. Department of Agriculture, Forest Service Bulletin No. 70, 1906.

content ranging in various woods from 22.5 to 31 per cent.[1] Also. that shrinkage begins at this point, no appreciable amount of shrinkage taking place in most woods during the evaporation of the water in the cell cavities.

The rapidity of evaporation is influenced by many factors, some inherent in structural peculiarities of different woods, some due to various methods of treatment. As a rule, light, soft woods dry out more rapidly than dense, hard ones. Water evaporates twice as fast from a radial section ("rift" or "quartered" face) and four times as fast from a cross section as from a tangential section ("flat" or "slash" face). Thin boards dry out rapidly and completely, soon reaching a state of equilibrium, after which the only changes are the slight amounts of absorption or evaporation that take place in consequence of changes in the surrounding atmosphere. In large timbers, many months or even years are required to evaporate the moisture from the interior.[2] Roth[3] state than "an 1-inch board dries more than four times as fast as a 4-inch plank and more than twenty times as fast as a 10-inch timber." Squares in which the rings run diagonally season most evenly, though they generally shrink to a diamond shape (see fig. 6); squares cut with the rings parallel to two sides are deformed less, but are more liable to check on the two tangential faces. This is due, of course, to the fact above mentioned that shrinkage is greater in the tangential than in the radial direction; the diagonal grain squares have all four faces of the same character, midway between radial and tangential, so that both evaporation and shrinkage take place evenly on all of them.

Shrinkage.—When the process of drying reaches the fiber saturation point, shrinkage begins. If wood were a homogeneous substance, this would affect only its size and not its form. A pressed brick, made of well-ground and evenly tempered clay, shrinks equally in all directions, without any distortion. Wood not only shrinks to varying extents in different directions, but shrinkage may be, and generally is, irregular even in any one direction. Lengthwise, wood shrinks only about 0.1 per cent,[4] but across the grain, from 2 to 14 per cent. Moreover, the transverse shrinkage is about two times as great tangentially (along

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[1] It is of interest in this connection to note that the lowest fiber saturation point ascertained was that of the heartwood of loblolly pine, a phenomenon analogous to the very low water content of heartwood of pines in the table cited on p. 21.

[2] An extreme illustration of the fact that large pieces of very dense wood do not dry thoroughly even in years is the following: About 1909 the Bureau of Forestry obtained a very large log of camagon which had been felled some thirty years before. The log measured 52 feet in length, 30 inches average diameter at the butt, and 20 inches at the top; it weighed 14,168 pounds. The log was whipsawed (there was no mill in Manila that would take the risk of sawing it by machinery) into boards ranging from 1 to 2 inches. No exact tests of weight were made. One of the largest planks, 1½ by 25 inches by 10 feet, was weighed on two occasions and a very slight decrease in weight observed. What is equally good proof, however, of loss of moisture and consequent shrinkage, is that practically every piece checked and warped more or less, one of the worst cases being that of a short piece 1 inch thick by 20 inches wide which warped nearly 1½ inches.

[3] Timber, by Filibert Roth, U. S. Department of Agriculture, Division of Forestry, Bulletin No. 10, 1895.

[4] "Timber: an Elementary Discussion of the Characteristics and Properties of Wood," by Filibert Roth, Bull. 10, U. S. Dept. of Agr., Div. of Forestry, Washington, 1895. Even within this very small limit, there is a slight difference between sapwood, or young wood, and old wood. This explains the frequently observed phenomenon of "spreading" on ripping in two a board containing mature heartwood in the middle and younger wood or sapwood along the edges and also the fact that logs, ties or other heavy timbers sometimes check at the ends, the separate parts spreading like prongs until, in extreme cases, the timber splits through its whole length.

the rings) as it is radially (across the rings). This difference is due, at least in great part, to the fact that in the radial direction the pith rays act like thousands of little struts that resist being compressed longitudinally. Sapwood and young wood generally shrink more than old heartwood. Add to these the irregularities caused by crossed and curly grain, by alternate hard and soft rings, and by the regional disturbances from knots and other interruptions of the normal straight course of the fibers, and it is easy to see that the probability of a given piece of timber warping is at least as great as that of its drying straight.

The amount of shrinkage varies greatly in different woods. Very few exact data are available for Philippine woods. Tests of about 35 woods made by the U. S. Forest Service[1] show the following maxima and minima of shrinkage from the green to the oven-dry condition:[2]

Shrinkage of American woods.

	Maximum.	Minimum.
	Per cent.	*Per cent.*
Radial	8.5	2.1
Tangential	14.2	4.9
Volume	21.2	7.0

It is a common, but erroneous, belief that all soft woods shrink more than do the harder ones. This impression is probably due to the fact that they dry out and shrink more rapidly, so that the shrinkage is more easily noticed, and also to their being often used very green for cheap and temporary work, while the harder woods are generally at least partly seasoned and so do not open up so much after finishing.

Figure 4 shows the effect on a round log of the excess of tangential over radial shrinkage. From the same cause the boards on either side of the heart of a log tend to warp outward as shown in figure 5. In figure 6 are shown the various ways in which squares cut from different parts of the log will act. (The hollowing of the faces is due principally to another cause, which is explained further on.) The square *a* will check on all four faces; *b*, which has the growth rings running diagonally across it, will be distorted into a diamond; *c*, which has them at right angles to its faces, will not be distorted, but will become narrower one way than the other, and *d*, which is part sapwood and part heartwood, will shrink more in the outer than in the inner half.[3]

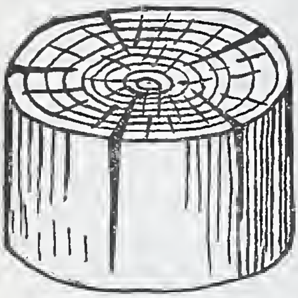

Fig. 4.

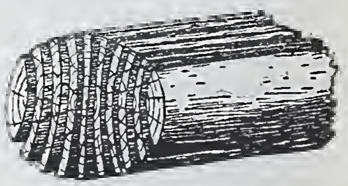

Fig. 5.

[1] Forest Service Circular No. 213.

[2] A fresh-sawn 1-inch plank of guijo (a wood comparable to the oaks in weight and hardness) donated to the working collection of the Philippine Bureau of Forestry in February, 1911, was exactly 48 inches wide; exposed to the air under an open shed, it shrunk to a little over 45 inches by August, 1911; during the extraordinarily dry, hot spring of 1912, it went down to exactly 45 inches, a total shrinkage in width of 6¼ per cent; afterwards it reabsorbed some moisture and in February, 1913, it measured 45⅜ inches.

[3] In some species, in accord with the general rule that hard woods shrink more than soft ones, the hard heartwood shrinks even more than the softer sapwood; in such cases, the square *d* would become narrower in the inner, not the outer, portion.

When a fresh-cut timber is exposed to the air or to artificial heat, water naturally evaporates first from the surface. A thin outer layer may be almost perfectly dry while the interior remains nearly green. Let us suppose a heavy timber to be dried approximately as far as the dotted line in figure 7. This outer shell cannot, of course, shrink except within its own thickness, for to contract as a whole it would have to compress the wet core. So, being partly dry, it hardens or "sets" in the form and size determined by its own shrinkage and by the size of the core. This is called "casehardening." Generally, the shell cracks more

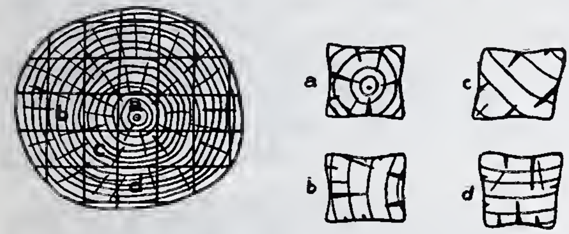

Fig 6.

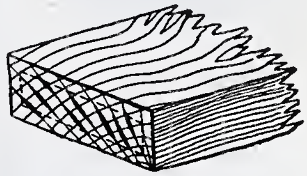

Fig. 7.

or less deeply from the surface inward (See fig. 6. *a–d.*) Straight-grained woods that split easily check deep and wide in a few places. Cross-grained woods become covered with a network of fine "superficial season checks." When the interior of the piece begins to dry out, it shrinks in its turn and tries to pull the shell with it. If the wood is one of a loose structure, that does not become very hard and stiff in drying, the shell follows the core and the season checks close sometimes so completely as to show only as fine lines.[1] Since the four corners of the shell are stiffer than the flat sides, they shrink less than the faces and these become more or less hollow, as shown in figure 6. If, however, the wood is one that sets very hard and stiff, the shell refuses to follow the core and the latter, trying to shrink and restrained by the stiff shell, has to split internally, as shown in figure 7. This is known as "internal checking" or "honeycombing." It occurs most easily in woods having large pith rays, like the oaks, and in dimension timbers. It is likely to be worse in flat-sawn than in quarter-sawn boards; in the former the pith rays, running at right angles to the faces of the boards, prevent these from following the shrinkage of the core, while in the latter they present no obstruction to shrinking through the thickness of the board. But severe honeycombing sometimes takes place in quarter-sawn oak.

The more rapid the process of drying is in the beginning, the more pronounced is the casehardening. It is worst when fresh-sawn wood is exposed to the sun, or placed in a steam or fire heated dry-air kiln. It is on this account that most of the earlier attempts to kiln-dry refractory woods were unsuccessful. In kilns where hot moist air or steam is admitted, casehardening is largely or entirely prevented. Most woods dried in the open air, but not exposed to the sun, will not caseharden enough to do any harm; but if a large timber is dried, even slowly, and then sawn into boards, the outer boards will warp as shown in figure 8, on account of the fresh, soft surface so exposed shrinking more than

[1] When a slightly checked surface of an insufficiently seasoned piece has been filled and painted or varnished, this subsequent contraction often squeezes the filler and varnish out, causing it to rise in narrow ridges above the surface.

the old, hard one. This often happens even in 2-inch or thinner boards that are resawn after partial or complete seasoning. A certain amount of casehardening, though very little, probably takes place under almost any circumstances. To this it is due that even seasoned boards, if resurfaced, again shrink a little. The hardened outer surface being removed, the fresh exposed surface perhaps loses a very small additional per cent of moisture and, being released from the restraint of a part of the "shell," shrinks a little more.[1]

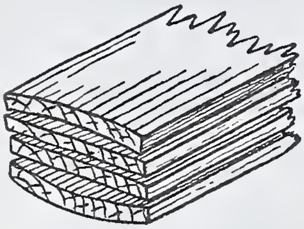

Fig. 8.

Increase of strength.—So far there have been considered in connection with the removal of moisture from wood only the changes of size and form that take place in drying. There are two other important results of seasoning—wood becomes much stronger in the dry than in the wet state and also much more durable.

Wood becomes stronger when dried, both absolutely—that is, in quality—and relatively—that is, in proportion to its dimensions. The dry fibers in themselves are harder and stiffer than when wet and, moreover, they cohere more strongly. Relatively to its size, a dry stick 1 inch square is stronger than a wet one of the same size because, owing to the shrinkage that takes place, there is a considerably larger number of fibers per unit area in the dry stick. Roughly speaking, air-dry wood containing 12 per cent moisture is from one and one-half to two times as strong as when green; kiln-dried to 3.5 per cent moisture, it is two to three and a half times as strong; and kiln-dried to 1 per cent of moisture, a piece of spruce was found to be four times as strong as a green stick of the same size.[2] Keeping in mind, however, the fact that kiln-dried lumber reabsorbs from the atmosphere an amount of moisture almost or quite equal to what it contained in the air-dry state, it is evident that the ratio given for air-dry lumber is the one that has the most practical value. Also, it must be understood that this applies to selected pieces of moderate size; investigations of the U. S. Forest Service show that, in clear pieces up to 2 by 2 inches, the strength invariably increases as the moisture content is lowered, but that above this size, the increase in strength is very irregular. In large pieces, due to internal strains and both internal and superficial checks caused by irregular drying and shrinkage, the proportional increase of strength is generally much less, and in badly checked pieces there is often even an actual decrease from the green to the dry state. An illustration of this may be seen in the figures for various degrees of moisture content in molave, Appendix 2, Table I. Molave is a wood peculiarly subject to checking in the course of drying.

Decay.—Wood is more durable when thoroughly dried, because decay does not take place without moisture. All forms of decay in wood are caused by bacteria or by fungi, principally the latter. Fungi are plants whose soil is vegetable or animal matter and, like other plants, they require oxygen, water, and a certain degree of heat, though many of them require little or no light. Deeply and permanently submerged in water, or buried

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[1] The fact is well known to woodworkers. A lumberman in Manila reports the case of a very wide and rather thick molave table top which, on being replaned on both sides, shrunk a few millimeters in width.

[2] Effect of Moisture on Strength and Stiffness of Wood, H. D. Tiemann.

so deep as to prevent the access of air, wood does not rot, because the fungi are deprived of oxygen; exposed to the air, but protected from water, it does not rot because the fungi can obtain no moisture.

Different kinds of decay are popularly known as "bluing" or "sap stain," as "wet rot" and "dry rot." Bluing, which is common in the sapwood of conifers, in cupang and other light-colored woods of the narra family, in the almost invariably white woods of the lanete family, in white nato, etc., is caused by certain fungi, or in some cases perhaps bacteria, which apparently attack only the contents of the cells, but not the cell walls, so that bluing affects the appearance of the wood, but has very little, if any, effect on its strength.

Wet rot and dry rot.—Wet rot is the decay that takes place where the presence of moisture is more or less evident to the eye. The fungi that cause it grow through all the elements of the wood and more or less completely destroy the cell walls, bringing about in time the entire disintegration of the wood.

Dry rot is not essentially different from wet rot; the fungi that cause it are such as can live and grow with only the small amount of moisture present in apparently dry wood or supplied by the surrounding atmosphere. From these statements it will be seen that seasoning or drying wood, provided it is done early and rapidly enough, not only absolutely prevents decay (unless the wood be again subsequently subjected to moisture), but that even incipient decay may be stopped by subsequent drying.

Weathering.—In addition to the forms of decay properly known as rot, there is one other cause of the destruction of wood, namely "weathering." This is probably a purely chemical process of oxidation, sometimes hastened by the abrasive action of sand or dust laden winds, but it is merely superficial and generally so slow as to be negligible when compared with the action of decay or of insects. Only in very dry and windy desert regions is the abrasive action of sand an appreciable factor in the destruction of timber.

Insects.—Dry wood is less liable to be attacked and destroyed by insect enemies than is green or moist wood. This is probably due principally to the fact that the green wood is softer and partly, also, to the nutritive elements being easier of assimilation than those of dry wood. It is certain that both various fungi and some insects work only in living trees, dying or abandoning the wood, as the case may be, when the trees are felled or when the wood is sawn up and seasoned.

Surfacing and finishing.—Finally, not only can dry wood, on account of its greater hardness and density, be surfaced more perfectly and given a smoother finish of paint or varnish, than can green wood, but the finish is more intimately incorporated into it and so is less likely to peel off, crack, or become dim as it so commonly does on unseasoned wood.

Benefits of drying.—To summarize the advantages of drying timber:

1. It decreases the weight, almost always an advantage, as great weight is desirable in wood only for certain special uses.
2. By bringing about the maximum possible shrinkage, it lessens the liability of future changes of form or size.
3. It increases the strength very largely, at least in selected clear pieces.
4. It prevents or arrests decay, unless the wood is subsequently subjected to moisture; but even under the most severe conditions, a well-seasoned piece begins to decay more slowly than a green one.
5. It lessens the liability to attacks by insects.

6. It increases the capability for receiving and retaining a fine and permanent finish.

The methods of drying wood are discussed under "Seasoning," p. 39.

FELLING AND TRANSPORTATION OF LOGS.

Opinions vary widely on the influence of the time of year and other external conditions on the processes of manufacture, especially as regards the first step, the felling of the trees. Three points are to be kept in mind in discussing this matter: (1) The effects of natural moisture content and of external influences on the log during the interval between felling and sawing; (2) the greater or less difficulty in sawing logs under various conditions; and (3) the effects of moisture content and of external conditions (temperature and humidity) on the first steps in the process of seasoning.

Most producers and consumers state that timber seasons better during certain months than in others, but as some connect this with the rainy or dry seasons, others with the hotter or cooler seasons, and still others favor certain months with no apparent regard to humidity and temperature, it is impossible to draw any conclusions from such conflicting testimony. It would seem extremely probable that in regions having a long and pronounced dry season, this must have more influence on the moisture content of a tree than would the temperature, and this belief is confirmed by the following:[1]

> "It is generally supposed that trees contain less water in winter than in summer. * * * This is not always the case. Some trees contain as much water in winter as in summer, if not more. The average weight of lodgepole pine ties of the same size cut at Bozeman, Montana, in June, 1902, was 157 pounds; in July, 144 pounds; in August, 150 pounds; in September, 157 pounds; in October, 164 pounds. It is probable that this increase would keep up throughout the winter."

When it is remembered that the moisture content of a living tree may be influenced by at least five factors, viz., characteristics of the species, season of greatest growth, soil moisture, atmospheric humidity, and temperature, it will be seen that it is impossible to lay down any general rule as to the time of year when a log may be expected to contain the least water, especially in a country where, as in the Philippines, all the above factors except that of temperature are extremely variable.

As regards transportation, whether by skidders and loaders, railways, ships, or by rafting, it is an advantage, on account of the lessened weight, to have the moisture content of logs as low as possible. For sawing, on the other hand, there is probably no doubt that the greener the log, the better. Especially with high-speed band mills, wet wood saws more easily than dry.

The influence of greater or less moisture content and of external conditions on the first steps of seasoning are discussed in connection with the subject of seasoning.

In one case certainly, namely, if logs must remain some time in the forest, it is better to fell them at the beginning of the dry season, as the rapid drying out of bark and sapwood, regardless of the slightly greater or less moisture content of the interior, will make them less liable to fungus and insect attacks. This, of course, is of no importance in species having a large and very durable heartwood; in fact, it is an ancient and widely known practice in the tropics to leave logs purposely in the forest until fungi and insects have completely removed the sapwood.

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[1] Seasoning of Timber, by Hermann von Schrenck, U. S. Dept. of Agriculture, Bureau of Forestry Bull. No. 41, 1903.

PAINTING ENDS OF LOGS—S IRONS.

Another ancient practice which the haste of modern operations has, in most parts of the world, caused to be forgotten or at least neglected, is that of painting the ends of logs. This has two purposes—the prevention of end checking, by retarding the excessively rapid evaporation of moisture from the cross section, and the exclusion of the germs of decay. Liquid tar, either hot or cold, or any very thick oil paint are the most efficient materials for this. In the teak forests of the Orient, a thick paste of clay and buffalo dung is often used. Now that there is a general tendency to complete utilization instead of merely great production accompanied by equally great waste, the practice of painting ends of logs is again being applied. At least one firm in the United States, who own their forests and carry out themselves every step from felling to seasoning, paint the ends of all logs, regardless of species, immediately after felling and bucking. In this case the object is not so much to prevent checking, as the logs do not remain long either in the forest or in the yard, but to exclude the possibility of bluing and other forms of decay.

End checking, followed by deep splitting, in logs and large timbers can be very much lessened by the use of S irons and crimp irons. S irons are thin strips of iron of narrow wedge-shaped cross section bent in the form of the letter S. Crimp irons are similar strips bent into a continuous wavy form by running them between cogwheels. When checks first begin to show in the ends of logs, posts, ties, or other heavy timbers, these irons are driven into them at right angles to the largest and longest checks. It is evident that this cannot prevent checking, but it effects a more important end, namely, to prevent the checks from opening and so extending deeper into the piece. S irons are used very extensively on railroad ties in Europe, as well as on bridge and other large structural timbers. Their use would be of great value in the Philippines on export logs and flitches. As they extend only an inch into the end of the log, the waste caused by digging them out, or sawing off the end of the log, is negligible compared to that which would be caused by deep splitting. Similarly, when it is considered how often railways ties have to be removed, not for decay or mechanical wear, but on account of splitting, it is evident that the expenditure of from two to four S irons on a tie that is seen to be checking while still in the tie pile, to say nothing of large pieces such as bridge timbers and piling, is a very cheap form of insurance against total loss.

SQUARING LOGS.

Since the first man split and hewed a single plank out of a trunk, the practice of squaring logs before sawing has been almost universal in all primitive lumbering operations. Where trees are abundant and the utilization limited, the waste was of no importance compared with the saving in transportation and the convenience of sawing the log into a number of boards of equal width. Where transportation has to be over great distances or is for other reasons very expensive, this may justify the waste even under modern conditions, especially in the case of woods having a large and very poor sapwood; in fact, in such cases the waste in squaring is relatively small. But close utilization, aided by modern methods of sawing and seasoning, demands that the whole log be used with no waste but what is unavoidable. How great the waste is in squaring can be seen from the fact that, to square a perfect cylinder, four-elevenths of its volume are removed. If a straight, round log be hewn on four faces so as to reduce

it to a roughly octagonal shape, the loss is much less; but considering taper, crooks, and other irregularities, it is easily seen that in squaring a log the loss may approach or even exceed one-half the total volume. Moreover, squaring brings with it other indirect causes of loss. A squared log is most likely to check deeply in the middle of the hewn faces (see fig. 6, *a*) just where the checks will do the most damage. Or, if it is of a species frequently having large heart cracks (so common, for instance, in ipil) and these are situated diagonally, every board they reach will be split, whereas in the round log the sawing can often be done parallel to the biggest crack, so that the defect will be confined to a few boards. Quarter-sawing a squared log, except to a limited extent after the "cant resawing method," is generally out of the question, as the resulting waste would be two or three times as great as in the original round log.

SEASONING IN THE LOG.

Practically all lumbermen are agreed that, with the exception of the slight loss of weight, there is no advantage in long seasoning in the log. The slight amount of drying that takes place in no way compensates for the severe surface checking, splitting of ends, and damage done by insects and fungi. This refers, of course, to logs lying in the forest or piled in the mill yard. With logs rafted to their destination or dumped into a log pond and left in the water until ready to be sawn, the case is different. Logs wholly or almost wholly submerged in water suffer no damage from insects and little or none from rot, while all manufacturers are agreed that they saw more easily and that the lumber sawn from them seasons more evenly and, it is claimed by many, even more rapidly. The more quickly logs are taken from the stump to the water, and the less time passes after their being taken from the water and before sawing, the less the logs will deteriorate. Timbers known to stain badly in fresh water or salt, and those known to be easily attacked by teredo in salt-water log ponds, should, of course, remain in the water as short a time as possible.

SAWING.

Previous to the American occupation, there were in the Philippines only a few small water power and steam sawmills. Probably 99 per cent of all timber was whipsawn. In spite of the fact that there are now a number of large American steam sawmills, a very great amount of lumber is still sawn by hand, not only in those inaccessible parts of the provinces that machine-sawn lumber has not yet reached, but in Manila itself. The most skillful sawyers, as a rule, are Chinese. That they are still able to compete with machinery is due to two causes: First, that they can easily supply small lots of material in odd sizes for special jobs, and, second, the extremely close utilization practiced by both sawyers and consumers. In the Filipino and Chinese hand-power sawmills there is almost no waste except end trimmings and sawdust. Extremely thin saws are used [1] and slabs and edgings utilized to such an extent that the average yard rarely has any firewood for sale. An instance of close utilization by consumers is the fact that the slabs from squared logs (which, of course, are flat, but have one sawn and one rough hewn face) are used for tops, backs, and bottoms of wardrobes and other furniture.

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[1] The writer found in Chinese lumber yards whipsaws that cut a kerf of only 0.075 (less than 1/13) of an inch, whereas the kerf of various vertical gang saws, band saws, and circular saws ranged from 0.14 to over 0.3 of an inch.

In the power sawmills, on the other hand, there has been up to the present little or no utilization of slabs, edgings, and other so-called "waste." In very large part, of course, this is due to the fact that the industry is comparatively new and channels have not been developed through which quantities of small-dimension stuff of special shapes and sizes can be disposed of. There is no doubt that, as the uses of Philippine woods become better known and as the lumbermen learn better to sort them out in the mill, many species will be used more closely than at present, both as to selection for special purposes and as to more complete utilization of the whole contents of the log.

QUARTER-SAWING.

It is easily seen from figures 5 and 6 that the boards least liable to warp are those sawn radially from the log; also, it is known from mechanical tests that such pieces are generally stronger and stiffer than those sawn tangentially; moreover, they season more rapidly, for water evaporates twice as fast from a radial as from a tangential section; and, finally, such boards have, in many woods, a more beautiful grain, such as the "silver grain" in the oaks and the "ribbon grain" in the cross-grained woods of the mahogany and lauan families. Wood sawn radially is called "quarter-sawn" and "rift-sawn;" that sawn tangentially, "flat," "bastard," or "slash-sawn."

Many methods have been used to obtain the maximum amount of quarter-sawn lumber from a given log. Three of these are shown in figure 9; from

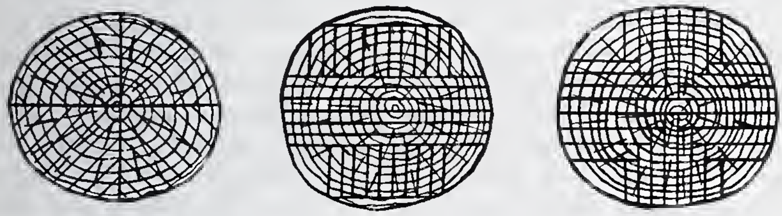

Fig. 9.

the first of these, in which the log is first quartered and the quarters sawn up diagonally, came the term "quarter-sawing." This method is the one probably least used now; it involves much more handling and waste in edging than does the second. Moreover, the second method, that of cutting logs into large cants which are resawn on another machine, lends itself to the production of large, sound pieces which can be shipped to other points and sawn, at or near the place of consumption, into boards or veneers suited to the needs of the consumer.

Strictly speaking, of course, quarter-sawn lumber is only that in which the growth rings run at right angles through the thickness of the piece. As only a small portion of the lumber from a given log can exactly fulfill this condition and as pieces only approximating it have practically the same appearance and mechanical properties as absolutely radial cuts, the general practice is to admit as quarter-sawn all pieces in which the rings form any angle from 90° to 45° with the face, those pieces in which the angle of divergence is less than 45° being classed as slash or flat grain. These conditions are shown in figure 10, (*a*) and (*b*) being rift and (*c*) flat grain. This rule obtains in America especially in the case of hard pine flooring. From the fact that the edges of the growth rings form the face of the board, such material is commonly known as "edge-grain flooring."

In the Philippines the selection of rift-sawn boards from the mill-run has been practised to some extent by a few skilled woodworkers, Chinese, Filipino, and American, who either knew that such pieces were less liable to warp or else chose them merely for their beauty, but broadly speaking, no distinction has been made until very recently between rift and slash sawn

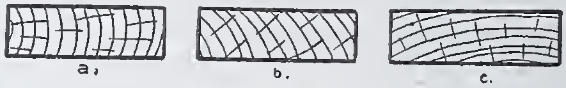

Fig. 10.

lumber. Within the last few years one firm has been selecting stock for export from their mill-run, with a view partly to general freedom from defects and partly to "ribbon grain," while another mill has been producing quarter-sawn lumber by cutting cants and resawing.

QUARTER-SAWING PHILIPPINE WOODS.

Quartersawing has not become as general in the Tropics as in the Temperate Zone. Where it is practised, it will probably be only in the case of certain woods and for special purposes. In such woods, for instance, as narra and tindalo, which shrink little and warp hardly at all if properly seasoned and bring high prices even in small dimensions, it will probably always be more profitable to get the largest possible amount of clear lumber out of the log, regardless of the direction of the grain. Moreover, the element of the appearance of the much-admired silver grain does not enter into the question to the same extent as in America, as most Philippine woods have only rather inconspicuous pith rays. In woods of very even grain and color, there is little difference in appearance between rift and slash grain. Such are: Alupag, amugis, anubing, aranga, bacauan, banaui, bangkal, bansalagin, the baticulins, batino, dungon, ebony, lanete, malacadios, molave, nato, pagatpat, sasalit, and others. Ringporous woods and those that have conspicuous regular or irregular rings of varying color generally show a more wavy and florid figure when cut tangentially than radially. Among these are: Acle, banaba, banuyo, batitinan, Benguet pine, bitaog, dao, ipil, calantas, malambingan, manggis, narra, pahutan, supa, tindalo, toog, tucangcalao, etc. A very few, such as the catmons and the oaks, have broad pithrays forming a conspicuous flake grain when quarter-sawn. The yacals, apitongs, and lauans—that is, practically all the abundant woods of the lauan family—are of very homogeneous structure (except that they are generally more or less cross-grained) and they have numerous but inconspicuous pithrays; consequently, they show little figure when slash-sawn and, when rift-sawn, little or no flake, but a very pronounced ribbon.

It will be seen that taste sometimes conflicts with practical considerations, many preferring the florid figure of slash-sawn to the regular ribbon of rift-sawn stuff. There is no doubt, though, that for such purposes as flooring, siding, ceiling, or broad, flat surfaces in furniture, the practical side should be considered first and rift-sawn lumber selected for such uses.

For the export trade in lauans and similar woods, the best results will certainly be attained by increasing as much as is practically and economically possible the amount of quarter-sawn lumber. Not only is it desirable to protect export material as much as possible against the defect of warping (for which there is no more certain means than the selection of rift-sawn stuff), but also the trade, especially in America, demands the "ribbon grain," which is shown only in the radial section.

SEASONING.

Since the invention and development of kiln drying, it has sometimes been stated that it is impossible to season wood naturally as well as it can be done in the kiln. On the other hand, one of the largest firms manufacturing dry kilns in the United States say in their prospectus that kiln drying is only a rapid way of doing what nature does better, though at the expense of more time. Both statements must be accepted with some reserve. It is probably true that, in spite of all the most recent improvements made in kilns, certain very refractory woods season better if at least the first steps of drying take place by the slow natural process, provided the lumber is meanwhile protected against the weather. Also, as has been stated above, wood will, if given time enough, dry out so far that it no longer swells and shrinks except to the slight extent caused by changes of the atmosphere. But thorough kiln drying reduces even this to a still slighter amount, because it lessens the capacity of the wood to reabsorb atmospheric moisture. Woods much subject to fungus and insect attacks are protected by being seasoned quickly in the kiln. And finally, certain very refractory woods, which formerly had no market value whatever (witness the notable instance of red gum) have become available for even fine cabinetwork solely through the agency of careful and thorough kiln drying. So, taking into account the lessening of waste, the economy of time and the improvement of the product, there can be no doubt that kiln drying, on the whole, is the better process. This statement does not, however, take into account the process of steaming followed by air drying which is described further on.

The choice between various methods depends in each case on many different circumstances. In small operations, the construction of expensive sheds or of still more expensive dry kilns or steaming apparatus may be economically impossible. Where a very large number of species of wood are handled, kiln drying, though not impossible, is rendered difficult by the fact that woods of widely varying character do not respond equally to the same treatment and the separation and increased handling make the operations more expensive; while in large operations handling a comparatively small number of woods, the saving of time in putting a seasoned product on the market easily compensates for the outlay in preparing it. On the other hand, the question of results attained may be more important than that of expense. Broadly speaking, rapid drying is liable to produce poorer lumber than slow, as it intensifies all the bad results of rapid and uneven shrinkage. Yet, in the case of woods liable to bluing, or to fungus and insect attacks, rapid drying is necessary, while durable woods, not subject to these dangers, may be seasoned as slowly as convenient. It is evident that no single method, or combination of methods, can be unqualifiedly recommended for a given case without carefully considering the circumstances of the case and the results required.

AIR-DRYING.

To dry sawn timber properly by natural means, only two things are essential—protection against sun and rain and thorough ventilation; protection, because green lumber exposed to the sun warps and splits more than it does under cover and alternate wetting and drying not only intensify these defects, but also increase the danger of decay; ventilation, because lumber in solid piles or in a closed storage place dries out slowly, or not at all, and, unless of an extremely durable species, rots before it dries.

The prime requisite, then, for storing fresh or partly seasoned timber is a roof. This is probably even more important in the Tropics than in the Temperate Zone. There is no doubt that the broadleaf woods suffer more from exposure to weather while seasoning than do the conifers, and almost all tropical woods are of the former class; in addition to this, sun and rain in the Tropics contribute more to the mechanical destruction of lumber than they do in cooler, drier climates, while the constant heat and humidity also increase the loss by staining and decay. Second, the lumber must not lie on the earth nor on the floor of the building. Stone, concrete, or wooden cross sills should be provided to hold the pile at least 1 to 2 feet above the ground. Third (and this is by no means the least important item), no two pieces should be piled one on top of another; cross sticks of uniform thickness (the commonest and probably best practice is to use 1-inch squares) must be put between every two layers. The sticks should be thoroughly dry, so as not to contribute to staining and decay at the points where they touch the lumber. Also, if the sticks are made of a species having poor sapwood, the latter should be excluded; for if the sticks are easily attacked by fungi or insects, they are very likely in turn to infect the lumber piled on them. Sticks for 1-inch lumber should not be more than 3 feet apart; one of the most modern mills in the United States places all cross sticks on 1-inch lumber at intervals of only 2 feet. If the tops of the sills are more than 1 or 2 inches wide, a cross stick should be put on each sill under the bottom layer of the pile. The sticks must be carefully laid in vertical rows above the sills and the two end rows should be placed at the very end of the lumber in the pile; the first precaution is to prevent the boards from being bent, as they certainly will be by the weight on the top of them if the sticks are not directly above each other, and the second one prevents cupping of the ends and minimizes splitting. If the sills are fixed in place and not so spaced as just to catch the two ends of the lumber, a platform of heavy planks or dimension timber of even thickness and as long or slightly longer than the lumber should be placed on the sills and the cross sticks be placed on this platform to suit the exact length of the boards. Except in extremely broad piles, sticks should be long enough to go clear across, so that they will help to keep the whole pile straight and level. In the case of very valuable lumber, or of small lots for special purposes, cross sticks should be put on the top of the pile and loaded with other lumber to prevent the uppermost boards from warping. Too much care cannot be taken in the first piling of green lumber, especially anything thinner than 2-inch planks. Careless piling may cause green boards to take twists that no subsequent treatment can ever straighten out.

Heavier timber, such as 2 or 3 inch plank, and large dimension stuff may be laid on sills more than 3 feet apart, but no dimension stuff should have less than three points of support, unless it be unusually short and heavy.

Under sheds, lumber is generally piled level. In the open, both in the United States and in the Philippines, the piles usually are inclined from end to end, the idea being that in this way they will shed rain most thoroughly. While this last is true, there are two disadvantages involved in sloping the pile longitudinally. First, any sawdust lying on the boards, as well as other dust brought in by the wind, tends to roll down the slope and accumulate at the edges of the cross sticks and to retain moisture there, thus increasing the liability to staining and decay along the lines

where the sticks lie across the lumber. Second, the spaces inclosed between each two courses or layers of lumber and any two sticks form chimneys through which, however, there is no natural tendency for circulation if they are level. A great improvement, therefore, is to slope the piles from side to side. In this kind of a pile the dust, whether started by any jarring of the pile, by rain water, or by wind, will tend to roll across the boards and fall through the spaces between them, so gradually working from top to bottom and falling below the pile. Moreover, the "chimneys" mentioned above will have a slope from end to end and any difference in humidity or temperature between the air within the pile and that surrounding it will tend to set up a draft through each one of these spaces from one side of the pile to the other. If it is desired to protect such a pile from the weather, a roof can be put on of short lengths of old boards laid across the top. In cases where still more thorough ventilation is thought desirable, either in the open or in the kiln, further and larger "chimneys," both horizontal and vertical, may be provided, the first by inserting two-by-fours on edge instead of the regular 1-inch cross sticks, say at about every 6 to 12 courses in the pile, and the latter by so arranging the boards as to leave two or more vertical openings a few inches wide and extending through the whole length and height of the pile.

End checking, especially in 2-inch and heavier timber, can be prevented to a great extent by nailing a cover of boards against the end or even by standing a sloping fence of boards against the end of the pile. This lessens the rapid evaporation from the ends both by excluding the heat of the sun and by lessening somewhat the free access of air.

In the Philippines practically all large mills, whether band or circular, have a stream of water running onto the saw to lessen friction, binding, and heating. Consequently, the lumber is often thickly covered with a fine paste of sawdust and water. In large operations it would be impracticable to attempt to remove this and, besides, in case of lumber stacked in the yard, most of the sawdust will be knocked off in handling or removed by wind and rain. For special lots of valuable lumber, however, it is advisable to wash it off, provided a supply of water is convenient to the yard or shed. The wood will dry more rapidly for having the pores on the surface freed of the paste that clogs them and will be less liable to become stained; it will be much easier to select the pieces later for special purposes; and it is unnecessary to explain that planing a clean board requires neither as much power nor as frequent whetting of the plane bit as does planing a dirty one. There need be no fear of retarding the seasoning or encouraging decay by once wetting green wood; the little water absorbed by the lumber will, in ordinary weather, evaporate in a day.[1]

Whether in the open or in a shed with an earthen or other floor, the ground around and under the piles must be kept clear of litter, such as sawdust, chips, and bark, as all of these furnish food and breeding places

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[1] The rapidity with which wood absorbs water is often overestimated. The following extract (Seasoning of Timber, by H. von Schrenk) shows this: "It was suggested that drying the ties in the woods would be useless, since they were to be put in the flume afterwards, where they would absorb as much water as they had lost. A test was therefore made to learn how much water dry ties would absorb. A number of ties cut sixty days before, and fairly well seasoned, showed an average weight of 116.61 pounds per tie. To float the 9 miles required about forty-eight minutes. At the end of their journey the average weight was 117.41 pounds, a total gain per tie of only 0.8 pound. Ties in the same seasoned state as these, after immersion in a stream for one hour, showed a gain in weight of 2 per cent, but two hours after they were taken from the water they had returned to their original weight.

for insects and fungi; nor should weeds be allowed to grow up around the piles, as they impede circulation of air and so retard the drying of the lower courses.

CARE OF SPECIAL PIECES.

All the above remarks on drying are based on the assumption that large numbers of pieces of ordinary dimensions are to be treated; it often happens that trade schools and other crafts shops have to take care of special pieces which must be kept for some time before they are fit for working up. In such cases a little precaution and a small expenditure of labor will often save serious deterioration of a piece or a considerable amount of work in surfacing and finishing it.

It is a common practice to nail strips on the ends of fine planks to prevent them from splitting in transportation or while seasoning. While this is an excellent precaution for the first reason, there can be no greater mistake than to leave such a strip on a green board for any length of time. It must be remembered that green boards shrink from 2 to 14 per cent in drying—that is, a board 3 feet wide will shrink at least three-fourths of an inch and possibly as much as 5 inches in width. Even a board of wood not naturally disposed to check is simply compelled to split in drying if it is prevented from shrinking by sticks nailed to the ends. The proper thing to do with such a piece, immediately on its arrival in the shop, is to put on each end a clamp, as shown in figure 11, with a wedge or pair of wedges at the edge of the board. While the board is still very green—that is, for the first few weeks—the wedges should be inspected and tightened every

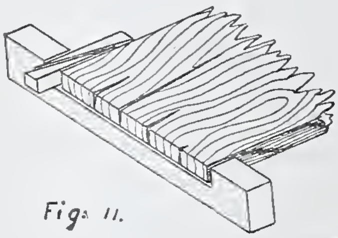

Fig. 11.

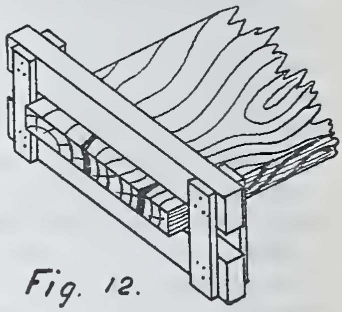

Fig. 12.

day or two. Later, a tap of the hammer once a week or so will keep them tight. If the wood is one in which warping as well as checking is to be feared, the clamps should be made double, with cleats across the ends as in figure 12. Wedges can be used with these also. It is, of course, impossible absolutely to prevent a board from splitting at the ends, but to a very large extent by these precautions the split ends can be prevented from spreading and the split from becoming longer. If a board is still perfectly fresh and little or not at all checked at the ends, a coat of any thick oil paint or shellac will often largely prevent checking. If a partly seasoned and badly split piece can be trimmed sufficiently to remove the split ends, and the fresh-cut end is then painted immediately, it is often possible to complete the seasoning with no splitting whatever.

Round table tops often warp badly after they are roughed out from the buttress roots of which they are generally made. By putting on them two or three clamps of the second kind not only can they be prevented from warping, but a warped piece, if it is not already too dry, can even be

partially straightened.[1] For this purpose the clamps must be pretty heavy, say 2 by 4 inches at least for a 5-foot table, and of a stiff wood, such as guijo, yacal, or ipil.

Single-piece table tops and similar large pieces are generally more or less casehardened when received at the shop. To make them season more evenly, it is advisable to surface them roughly with adz and jack plane before putting on the clamps. If a piece is much thicker than necessary, it is well to do the dressing down in several stages at considerable intervals of time. In this way the casehardening becomes less severe after each successive surfacing and the danger of deep checking is correspondingly lessened.

TIME REQUIRED FOR SEASONING.

The time required for thoroughly air drying lumber varies considerably in different species and according to external circumstances. As a rule, light, soft woods season much more rapidly than hard, dense ones, although the latter generally contain much less water when green. Also the season of the year has much to do with it, not so much as concerning the original water content, but as influencing the temperature and humidity of the air.

A very large part of the moisture in fresh woods evaporates during the first few weeks. Tests made by the U. S. Bureau of Forestry in 1902 show that green railroad ties of pine, piled in open piles out of doors, lost moisture with great rapidity the first three to six weeks; then came a period of a few weeks when the rate of drying diminished rapidly, after which it again became steady, but extremely slow. A typical case is the following: First three weeks, loss of weight over 30 per cent of green wood; end of next two weeks, about 36 per cent; end of following six weeks, nearly 40 per cent. These tests were made during the hottest and dryest months—July to September. Now, the significant fact here is not the rapidity of evaporation in the beginning, but its extreme slowness during the last six weeks. Probably one-half or more of the original weight of the ties was water (see table on p. 21), so that, having lost two-fifths only (40 per cent) of their weight in eleven weeks and the rate of loss being but 4 per cent in six weeks, it is easy to see that it would take many months to reduce them to an even approximately air-dry condition. While there are few exact data on the seasoning of Philippine woods, there is no reason to believe that, taking climatic differences into account, it will not take place in essentially the same way.[2]

The time of year when lumber is sawn and the process of seasoning begins may have a considerable influence not only on the first steps of this process, but on the quality of the final product. It is hardly necessary to say that, if sawn lumber is first exposed to the air during the hottest and dryest months, it will begin to season much more rapidly than during the height of the rainy season. To appreciate the final effect of this, what was said above about rapid and slow seasoning must be remembered, namely, that rapid seasoning most effectively prevents or at least minimizes bluing and deterioration by decay and insects, but, on the other hand,

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[1] The 10-foot dao table in the collection of the Bureau of Forestry at Manila was badly warped when received. By putting on three clamps of 6 by 8 inch timbers, wetting the piece thoroughly morning and evening and driving wedges of hardwood under the clamps, the warp was reduced by about 3 inches in the course of a few weeks.

[2] The shrinkage of the guijo plank mentioned above (footnote, p. 30) was over 1 inch during the first month or so; after that it shrunk so slowly that sometimes scarcely any difference was noticeable from week to week; but it continued shrinking for considerably over a year until the total shrinkage amounted to 3 inches.

intensifies all the various defects caused by irregular shrinkage—that is, warping, twisting, splitting, casehardening, and superficial and internal checking. Soft, light, and perishable woods, therefore, would best be sawn and piled at the beginning of the hot season, so as to get rid of the greatest possible amount of moisture in the least possible time. Hard, dense, and durable woods, and especially such as warp and caseharden badly, should rather be sawn and piled at the beginning of the rainy season, so that the first steps in drying may be as slow as possible.

For ordinary work, where only a fair degree of freedom from shrinking and warping is required, 1-inch boards of such woods as calantas, tanguile, the lauans, and softer grades of narra can be used when only a few months old, but for good flooring or inside finish and for fine furniture and cabinet-work, they should be air-dried (under roof and well ventilated) at the very least for one year. Hard, dense woods, such as molave, tindalo, acle, palo maria, and, above all, ebony and the camagons, require still longer periods. One-piece table tops, which in the rough are generally upwards of 1½ inch thick, should never be made up until at least a year old and then only after repeatedly dressing down as described above.

KILN DRYING.

The first attempts to season wood artificially on a commercial scale were made by storing lumber in closed chambers with a circulation of air heated by means of furnaces or of steam coils. If "seasoning" meant merely drying, it could be said that these early kilns seasoned the wood; but seasoning in a broader sense means reducing green wood to the dry state with the least possible distortion and deterioration as to mechanical properties. In this sense the dry-air kiln does not season most woods. The coniferous woods, with their very homogenous structure and straight grain, as a rule suffered the least from the process. Among the broadleaf woods, certain light, porous species which season rapidly and evenly in the open air were also little injured in the kiln. But a large proportion of the latter and even some conifers suffered so much from warping, casehardening, and consequent superficial and internal checking that kiln drying by many wood users was believed to be worse than useless, and it was frequently stated that only thoroughly air-seasoned lumber was fit for the most exacting purposes. The dry-air kiln is now practically obsolete. When it was realized that the chief defect of the dry-air kiln was the uncontrolled and excessively rapid evaporation from the surface, experiments were with made moist air. Exhaust steam, live steam, and water jets have been used to supply the proper degree of moisture. In certain types of "progressive-process" kilns, the moisture in the wood itself is largely used. A progressive or continous process kiln is one in which the lumber enters green at one end and is taken out dry at the other. In such kilns the continuous supply of moisture from the green lumber is supposed to be sufficient to prevent casehardening.

Though moist-air kilns were a distinct advance, the earlier ones failed as a rule to provide one essential, namely, the heating of the timber through its entire thickness and maintaining it at a sufficiently high temperature throughout the whole process. Moreover, the manufacturers and users did not take sufficient care exactly to ascertain and to maintain the necessary amount of circulation and the proper degrees of heat and humidity. The use of positive means of regulating these conditions, aided by thermometers, hygrometers, etc., is doing much to improve results.

Some of the most recent types of kilns employ live steam under pressure to secure the complete penetration of heat to the interior of the wood. The earliest experimenters along this line believed it to be sufficient to heat the wood in this way for a certain period, ranging from a few hours to several days, and then completely to shut off the steam. In this way, it was believed that the expansion taking place on removing the pressure would be sufficient to drive out and evaporate all the moisture in the wood. This theory failed to take into account the fact that the heat in the interior of the timber was absorbed by expansion and evaporation before all the water was driven out. The result was that such timber, although apparently dry on the surface, frequently came out of the kiln with a considerable amount of moisture still remaining in the interior.

The use of steam at high pressure involves also the danger of weakening the wood permanently. Experiments made by the U. S. Forest Service at the Louisiana Purchase Exposition with pine ties subjected for four hours to steam pressures ranging from 10 pounds to 100 pounds showed that the ties were weakened from 11 to 59 per cent.[1]

The most recent summing up of the results of experiments in kiln drying is given by H. D. Tiemann[2] as follows:

"The Forest Service has for a number of years made experiments in drying lumber on a small scale and has reached what are believed to be fundamental principles. To apply them effectively will require expert knowledge until the proper constants of operation have been determined, because no one detailed method of operation can be prescribed at the present time. It is believed, however, that great improvements in methods of drying can be securred by applying these conclusions. * * * The experiments made by the Forest Service indicate that successful dry-kiln operation requires the observance of the following points, which embody the basic principles of the process:

"1. The timber should be heated through before drying begins.

"2. The air should be very humid at the beginning of the drying process and should be made drier only gradually.

"3. The temperature of the lumber must be maintained uniformly throughout the entire pile. For this an exceedingly large circulation of air is essential.

"4. Control of the drying process at any given temperature must be secured by controlling the relative humidity, not by decreasing the circulation.

"5. In general, high temperatures permit more rapid drying than do low ones. The higher the temperature of the lumber, the more efficient the kiln. It is believed that temperatures as high as the boiling point of water are not injurious to most woods, providing all the other fundamentally important factors are taken care of. Some species, however, may not be able to stand as high temperatures as others.

"6. The degree of dryness attained, where strength is the prime requisite, should not exceed that at which the wood is to be used."

The rules above quoted apply, of course, to the actual drying of lumber in the kiln. Various processes of steaming have been tried which failed, for the reason previously explained, to give satisfactory results—that is, really to dry the lumber. Recently, however, steaming has again been introduced, especially in the Kraetzer process, not to dry the timber, but merely to prepare it for rapid air drying. The felling, transportation of logs, and sawing are all carried on with the greatest possible rapidity so that the timber may enter the steam cylinder as nearly as may be in the

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[1] Effect of Moisture on the Strength and Stiffness of Wood, by H. D. Tiemann. U. S. Dept. of Agr., Forest Service Bull. 70, 1906.

[2] Principles of Drying Lumber at Atmospheric Pressure and Humidity Diagram, U. S. Dept. of Agri., Forest Service Bull. 104, 1912.

green state. After steaming at a low pressure for a short time the lumber is taken out and left to dry in the open. In addition to the central feature of the process, great care is used in sorting the timber by species and sizes and in stacking it very exactly. If the results are as good as claimed, both as to saving of time and excellence of product, this is no doubt due not only to the steaming process, but also in large measure to all these other precautions. In one regard, the process could still be improved or rather augmented, namely, by drying the lumber under sheds. Especially would this be the case in a country like the Philippines, where dry weather is the rule for only a few months of the year, while the temperature remains high even during the rainy season.

WORKING AND FINISHING.

It is not proposed to make this a treatise on woodworking, nor to give any detailed directions for shaping and finishing. The following notes are rather intended to point out certain broad principles to be followed, with special reference to Philippine woods, and certain pitfalls to be avoided.

CHARACTER OF WOODS.

As a general rule, the even and straight grained woods of the conifers are easier to work and to finish than broadleaf woods. As remarked above, the woods of the Philippines, as well as other tropical regions, are practically all of the latter class. It is a common but erroneous belief that the great bulk of tropical woods are very hard and very heavy. Whatever may be the case in other tropical countries, this is certainly not true in the Philippines. The two most widely known tropical woods (with the possible exception of ebony) are mahogany and teak. Neither of these is very hard or very heavy. Teak is quite easy to work and mahogany much easier than the hickories and the hardest oaks. Now, statistics of the total cut in the Philippines from 1901 to 1914 show that about eight-seventeenths consisted of woods softer and easier to work than the two above named and nine-seventeenths of hard to very hard woods. Also, it is known that the total cut of the softer woods is proportionately much less than the total stand of these species in the forests, so that undoubtedly future production will show a still larger proportion of the softer woods. Especially will this be true in the case of export woods. The lauans and similar soft woods are no harder to work than medium-grade pines, except that, on account of their generally somewhat crossed grain, they are more difficult to surface. A majority of the harder woods are of fine and even texture. Comparatively few have the grain so crossed or curly as to make surfacing very difficult, and only very few are notorious for dulling tools rapidly.

As regards, then, the "hard tropical woods," the situation in the Philippines is this:

1. The softer commercial woods of the Philippines are much easier to work than the oaks and hickories.
2. They are more abundant, not in number of species, but in total bulk, than the hard and heavy woods.
3. They are being exported in greater quantities than the very hard woods.
4. The heavier woods are, as a rule, difficult to work only on account of their hardness and not especially on account of other qualities, such as toughness or crossed or curly grain.

SHAPING AND SURFACING.

Regardless of all inherent properties of a given wood which make it suitable for certain uses, the prime requisite in selecting and preparing material for a job is that it be well seasoned. Perfection of finish and lasting qualities of the product depend absolutely on this. Moreover, the lumber for a given job should have been seasoned in sizes approximating as nearly as possible the rough size of the pieces to be gotten out. Large pieces, whether air-dried slowly for years, or kiln-dried by the most perfect of modern processes, are likely to have the inner and outer portions in different conditions of strain which may cause even thoroughly dry wood to warp, twist, or shrink slightly when these strains are released by cutting up a large piece into smaller dimensions.

In roughing out with the saw, the lines of the finished pattern should be followed closely, as the often-mentioned cross grain in softer woods, or the hardness of the denser ones, make it more difficult to remove surplus material with plane, scraper, and sandpaper than is the case with the conifers, or with a soft and straight-grained wood like poplar. In planing, whether by hand or machinery, the final cut must be very thin, as a heavy cut will almost invariably lift the grain in spots or streaks. Philippine woods, especially the softer and more brittle ones, will rarely give up long splinters in this way, as the pines frequently do, but will lift and break at extremely short intervals, leaving a more or less deeply roughened surface that is difficult to smooth with scraper and sandpaper. Frequently, in pieces having a very pronounced and narrow ribbon, the easiest and quickest way to surface is by planing across the grain, taking only a very fine final cut lengthwise. This is a common practice among Chinese and Filipino carpenters.

The worker in tropical woods will find more use for the scraper than is common in woods of the Temperate Zone. On the finest grained and hardest woods a scraper sharpened to a fine bevel edge often gives better and longer service than the turned edge most commonly used by American cabinet-makers. This depends partly, of course, on the temper of the scraper.

Every woodworker knows that sandpaper is to be used only when plane and scraper have done all they can to produce a level and smooth surface. Nowhere is this truer than in the case of most Philippine woods. Many of even the softer ones resist abrasion to a remarkable degree, while in the hardest ones to try to work a surface down to the slight depth of a slivered or chipped spot is a hopeless task. On the other hand, Philippine woods are remarkably free from resinous and oily substances, only apitong and pine being resinous enough to gum tools and sandpaper, and one wood, batete, distinctly oily; on all others, even the finest grades of sandpaper work freely and without gumming.

Machine sanders can use somewhat coarser grades of sandpaper and take off deeper inequalities than the handworker can afford to, but even for such work it pays to keep the planer in such shape that it will leave as little as possible for the sander to do.

Steel wool is excellent for certain woods. On soft woods of coarse texture and on such as have a broad, open grain (narra and batitinan, for instance, which somewhat resemble ash in this respect) it cannot be used, as it is liable to dig into the soft grain. On dense, hard woods of very even texture, however, steel wool cuts more quickly and with as good

or better results than sandpaper. Also it has been found very serviceable in rubbing down raised grain after putting on a filler or a first coat of shellac or other polish.

VENEERS.

The manufacture and use of veneers on a large scale is practically unknown in the Philippines with one exception. This exception is the manufacture of matches, in which, both for match sticks and for boxes, the wood is cut on rotary veneer machines. Skilled cabinetworkers and musical-instrument makers use small panels of veneer or overlays for ornament; the entire bodies of guitars and similar instruments are made of very thin stuff, but as they are not laid over a base of other wood, it is only on account of their thinness and not as regards the manner of using them that they could be classed as veneer. No American manufacturers have as yet installed any veneer machinery. Small quantities of Philippine woods have been used for veneer by European firms and a few experimental lots have been made by manufacturers in the States. There is no doubt that many of the less abundant Philippine cabinet woods could be used as veneer rather than solid to great advantage, both as regards the appearance and durability of the product and as regards economy. Very probably even the best flitches of tanguile and the lauans could be so used more profitably than in the solid form. The special uses of certain woods for veneering are further discussed in Part III, under "Veneer."

JOINTING AND GLUING.

In all work involving jointing and gluing, the oft-repeated caution about using only thoroughly seasoned material should be kept in mind. By means of battens, cross banding, rim binding, etc., wood can be prevented from swelling, if not entirely, at least sufficiently to prevent conspicuous unsightly results. Moreover, such results of swelling as sticking of doors or drawers are, as a rule, easily remedied. But no amount of battens, screws, dowels, or gluing can prevent wet wood from shrinking when it dries. If a piece is so firmly held that it cannot shrink as a whole, it must split. In any case, gaping miters, open joints, or split panels can be repaired only by complete rebuilding, or by the use of unsightly patches or putty that betray the original poor work.

In addition to the danger of damage from shrinking there is another important reason for using dry wood in all glued work, namely, that glue takes a much better hold on dry wood than on wet. The reasons for this are two: First, that the glue penetrates the surface and so incorporates itself more thoroughly with the wood; and, second, that it dries and hardens more thoroughly.

There is probably no department of woodworking where extreme care and accuracy pay better in the form of good and lasting results than in jointing and gluing.

FINISHING.

Paints.—Paints, and also varnishes, have two chief purposes—preservation and ornament. Broadly speaking, paint serves more frequently for the former and varnish for the latter purpose.

A piece of sound wood, thoroughly seasoned, cannot decay as long as it is kept covered with an unbroken coat of paint or varnish, for these prevent the entrance, not only of fungus spores, but also of the moisture

which is necessary for their germination and growth. It must be kept in mind, though, that on unseasoned wood paint may be worse than useless, for if fungus infection already exists under the surface, the paint not only does not destroy the fungus, but will even facilitate its growth by retarding the evaporation of the water contained in the wood. Also, though thorough painting will retard checking to some extent, it cannot prevent it in large pieces of unseasoned timber, and as soon as the coating of paint is broken by checking, an entrance is given to fungus spores. It is often better, therefore, to leave unseasoned timber unpainted for a time than to paint it prematurely.

The above statements apply practically to insect attacks also. Insects will rarely bore through a coat of good paint. Even termites ("white ants") prefer to make their attacks at points not covered by paint, such as cracks, knot holes, or joints into which the paint has not penetrated.

To make paint best serve the purpose of preserving wood, then, the following points must be observed:

1. The timber should be dry, not only to avoid the dangers above referred to, but also to secure good adhesion of the paint.

2. All cracks, knot holes, or other openings must either be thoroughly filled with paint or, if too large for this, carefully closed with a non-shrinkable putty. Putty is generally best applied after the first and before the second coat of paint, as it sticks better to painted than unpainted surfaces. All places where two pieces of timber are in contact, and, above all, where ends are joined or butted against other pieces, should be given a heavy coat of paint before joining, and, if not close fitting, puttied also. There is no place where dry rot starts in more frequently than at covered, but unpainted, butt joints.

3. Cracks, knots, or joints opening later, especially if situated where water is likely to run in, should be puttied and painted again, preferably after a period of hot, dry weather. At such a time there is the least danger of shutting up both fungus spores and water inside the timber and also the cracks are less likely to open still wider and so loosen the putty.

4. Finally, it must be remembered that, as far as termites are concerned, all these precautions are useless if there remains any part of the timber unprotected and accessible to the termites, especially the buried portion of posts.

Where paint, as on much interior work, is used chiefly for ornamental purposes, all the above precautions are naturally equally advisable as a matter of securing permanency.

Enamels.—Enamels are, so to speak, paints mixed with a varnish base or vehicle instead of oil. They are superior to paints in giving a smoother, harder, tougher, and, therefore, more durable surface. Also, they are capable of being rubbed, like varnishes or polishes, to either a gloss or matt finish. They are generally applied, for the best results, over one or more coats of paint of the same color as the finish.

Stains.—Stains, in the strictest sense of the word, are solutions of coloring matter in oil, alcohol, or water, intended to color the wood without in any way covering or obscuring the natural texture. Many substances are employed for staining which, while not conveying color in themselves, cause changes in the color of the wood by chemical means. As far as results are concerned, they have the same effect as colored stains proper—that is, they produce the desired color without obscuring the grain. Any mixture containing a solid pigment, not in solution, but in suspension (as

are the pigments in paints and enamels), is not, properly speaking, a stain, but approaches a paint or colored varnish. Stains should, as a rule, be applied to the raw wood, before any filler or other first coat is used, as only in this way the full coloring effect can be obtained. The application of a stain frequently roughens the surface slightly, or "raises the grain," as woodworkers say. In such cases, the surface should be gone over lightly with fine sandpaper or steel wool before applying a filler or a first coat of polish. Chemical stains are not easily affected by any subsequent application of varnish, but stains in the nature of colored solutions are sometimes easily redissolved by the vehicles of fillers, varnishes, etc. When such have been used, therefore, the first coat of finish should be applied rapidly and without much brushing or rubbing, so that the alcohol or other vehicle of the first coat of finish will not soften and carry away the stain.[1]

Fillers.—Fillers are more or less thin pastes made of powdered solids mixed with a small amount of liquid and used (as the name indicates) to fill the pores, or even fine superficial cracks and joints, to a firm and level surface before applying the first coat of varnish or polish. They are made of a great variety of mineral and vegetable substances, the commonest of the latter being starch. They are colored with pigments, similar to those used in paints, to suit the color of the wood on which they are used or to match the stain applied to the wood. Sometimes striking effects are produced by using dark fillers on open-grained woods like oak, causing the broad open grain to form a conspicuous pattern on the lighter back ground of the dense wood, where the filler does not take hold.

The commercial "paste fillers" are generally intended to be "cut," or thinned, with some solvent before applying. For this purpose alcohol and turpentine are commonly used, but where gasoline can be had it is the most convenient vehicle. Besides being cheaper than turpentine and, in some places, even than denatured alcohol, it has very little effect on the grain of the wood and dries more rapidly than any other solvent. The filler should be mixed to the consistency of a thick paint and applied with waste or a large stiff brush, rubbing it well in across the grain of the wood. The time necessary to elapse between applying it and rubbing it down depends so much on the character of the wood, the kind of filler used, and the weather, that no fixed rule can be given for it. The filled surface must be watched and frequently tried after application to see that it has set enough to rub down without removing the filler from the pores and, on the other hand, has not set so hard as to make difficult the removal of the surplus from the surface. If a large amount of filler remains on the surface, the bulk of this can be easily and conveniently removed with a scraper, if care be taken to pass the scraper over very lightly. The remainder should be rubbed down very thoroughly across the grain or with a rotary motion with waste, rags, or soft shavings, and then left to dry and harden before applying varnish or polish.

A common method of filling porous woods in the Philippines is to rub

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[1] An excellent stain for occasional bits of sapwood of narra (or for other white woods) is made by soaking sawdust, shavings, or planer chips, of very red narra in alcohol (grain, wood, or denatured). This gives a solution resembling a dark, but perfectly clear, red ink. One to three coats will serve to give almost any white or light-colored wood a fine red color. It is also used to darken light grades of narra or to make the color of very streaky stuff more even. This tincture is sometimes used for making up shellac and other polishes, giving a clear red polish of the same body as if made with pure alcohol.

them down with powdered pumice stone and oil. This produces a hard and smooth finish, the pores being filled very thoroughly with a mixture of the powdered pumice and wood, but with the disadvantage of obscuring somewhat the grain and, especially in brillantly colored woods, also the color. The color effect of this process can be improved by mixing with the pumice stone an appropriate mineral pigment, such as umber and sienna for brown and red ochre or Turkey red for dark-red woods. The more nearly the pigments are tempered to suit the color of the wood, the less will the filler show after polishing.

Combination stains and fillers and combined stains and varnishes are also prepared by paint and varnish manufacturers, but their number is so great and applications so varied that they can not be discussed here. The combination stains and varnishes are, as a rule, merely household makeshifts for the amateur and are little used by professionals.

It should be noted that the color effects of stains and fillers can rarely be judged accurately before drying. For this reason, where a given effect is desired, several samples of the wood to be used should be surfaced, stained or filled as the case may be, and then given a brush coat of shellac or other varnish. Only in this way can the final result be properly judged. Also, the future behavior of the wood as to color should be kept in mind. If a light filler be used on anubing, antipolo, nangka, or the yacals and mangachapuys (all woods that are light yellow when fresh, but turn more or less dark brown on exposure), the filler will later make the pores show as light streaks on a dark surface. It should, therefore, be made of a light-brown tint in the first place, so as not to contrast too strongly with the wood when this darkens. If it is desired to preserve light-colored woods in as near their natural tint as possible, the filler should contain a minimum of oil, as practically all oils not only tend to darken wood immediately on application, but cause it to darken slowly later. Many commercial paste fillers contain more oil than is desirable for use on very light-colored woods. This can be removed by stirring the filler up with about an equal bulk of solvent (gasoline, turpentine, or alcohol) letting it stand over night to settle and pouring off the liquid, when there will be left a practically oil-free paste, which is then again to be diluted to the proper consistency for use.

Wax finishes.—One of the oldest and most widely known methods of polishing wood is by means of wax. Beeswax is the commonest material, though various vegetable waxes have also been applied to the same use. A wax finish has the advantage of serving at once as filler and polish and can also, to a certain extent, be made to serve as a vehicle for colors, so that in certain kinds of work the finishing, including staining, filling, and polishing, can be done by one or more applications of a single material, instead of the successive application of stains, fillers, and polishes. However, better results are obtained, especially in very open-grained woods, by using a good filler first. Pure beeswax, with sufficient rubbing, gives a highly polished, but not hard and durable, surface, requiring very frequent repolishing. The modern varnish industry, therefore, employs a variety of substances to give a more resistant surface to the finish. Certain liquid or semiliquid wax finishes, applied like paint with a brush, contain mineral powders, resins, etc., which cause the finish to dry with a hard surface. Wax furniture and floor polishes, applied not with a brush, but by rubbing, contain various vegetables waxes (many of which are harder than beeswax) or else a sufficient amount of resin to give them a harder surface.

Wax finishes are among the easiest to apply with satisfactory results. Whereas practically all varnishes and polishes require a certain amount of skill to produce a smooth surface, a wax finish on a well-surfaced piece of wood can be applied with no previous practice, the smoothness and polish of the finish depending principally on the energy of the operator.

One caution must be observed regarding wax—it must not be used as a filler or undercoat on surfaces to be finished with paints, enamels, or varnishes, as these are liable to remain tacky or else in time to scale off when applied over wax. Even shellac varnish, which hardens better over oily surfaces than do enamels and turpentine varnishes, is apt to crack or scale when put on over wax. Neither should wax be used to repolish varnish, as it is liable to soften the varnish and make it tacky. Wax can be used with perfect safety, however, over shellac. In fact, fine waxed floors are now often finished by using first a filler (stained or not, as the case may be), then one or more coats of shellac, and finally wax to give the smooth, softly shining finish characteristic of the latter material.

In purchasing floor wax, it should be noted that the best kinds remain solid even in very hot weather. Any floor wax that becomes semiliquid when the thermometer goes above 90° is to be distrusted, as it will probably not give as resistant a finish as one with a higher melting point.

Varnishes.—Varnishes are compounded of many different kinds of resin, generally combined with oils that dry quickly and completely, both dissolved in turpentine as a vehicle. They differ from paints in that they are transparent and that a varnish dries as a homogeneous mass which can be rubbed down with sandpaper, steel wool, or powdered pumice stone to any desired degree so as to remove all brush marks and other inequalities, thus leaving a smooth surface of even texture. Turpentine varnishes can be, and very frequently are, used over fillers, stains, and even oil paints, but the undercoats must be entirely dry before the varnish is applied. The first coat is generally very thoroughly "brushed out"—that is, rubbed in and spread out with the brush—in order to incorporate it well with the wood, or whatever undercoats may have been put on the wood. For further coats, the varnish is diluted with a greater quantity of the solvent, or vehicle, and is "flowed on"—that is, quickly and lightly spread with a full brush—so that the liquid will spread out in a smooth sheet, without showing brush marks. In all cases where a smooth finish is desired, every undercoat of stain, filler, or varnish must be rubbed down lightly with very fine sandpaper or steel wool to remove brush marks, raised grain, and other slight inequalities. For very fine work, such as coach and piano finishing, several coats are rubbed down, almost or quite to the grain of the wood, each with successively finer polishing materials. When a dull or matt finish is desired, the last coat is rubbed with the finest grade of steel wool, bolted pumice, or still finer polishing powders such as rotten stone. These powdered substances are used on a pad of clean cotton waste or a soft rag, with water or oil. Some of the finest cabinetwork is finished by doing the last polishing with rotten stone and the palm of the hand.

"Flat varnishes"—that is, varnishes that dry without a high gloss—are often used where a dull finish is desired. Many of these contain a certain amount of wax and, therefore, should not be used where it is probable that the surface will be exposed to wear and so have to be refinished, for neither varnish nor paint, as remarked above, will take a good hold on a finish containing wax.

Polishing.—The following directions for polishing with varnish or with spirit polish (shellac) are from an article on the subject by F. W. Cheney,

Philippine School of Arts and Trades, in "The Philippine Craftsman" for February, 1913:

"*Shellacking.*—This part of the work is omitted in finishing cheap work on softwoods. It is recommended in work on hardwoods, because it gives a better surface for the varnish. Shellac dries very quickly and does not sink into the surface and dissolve the oil in the filler.

"The first step is to see if the filler is perfectly dry. About the only safe way is to give plenty of time to dry and then a little more—about twelve hours more than is directed by the manufacturers, to allow for the difference in climate between this country and the United States. A good formula for shellac is as follows:

Alcohol	1 liter.
White shellac	100 grams.

(Increase in proportion for larger quantities.)

"Dissolve the shellac in the alcohol and stir or shake often while using, as the shellac will settle very quickly. If the alcohol is warmed, the shellac will dissolve faster. This can be safely done by placing the can or bottle in warm water. See that the surface to be shellacked is clean and free from dust. Apply the shellac evenly with a soft, flat brush. Cover all projecting parts, such as panels, first. Spread the shellac across the grain, taking only a small amount on the brush at one time. Allow twenty-four hours for drying and go over the work lightly with fine sandpaper (No. OO). It is now ready for varnishing.

"*Applying varnish.*—The real problem in using varnish, under the ordinary conditions that obtain in our school shops, is that no room is available that is 'dust proof.' The following plan is suggested as a makeshift: Select the best room available; a classroom with tight windows and doors will do. It must be well cleaned up perhaps on a Friday afternoon. On Saturday morning have it swept with wet sawdust, which will pick up most of the dust on the floor. With cloth, wipe off all articles of furniture or parts of the woodwork that are likely to be disturbed or touched by the workman. Dusting with a brush will not do. It only stirs up the dust, which settles elsewhere. All windows should be closed before the last dusting and not opened or disturbed until the varnish is dry. Wipe off the surfaces to be varnished with a soft cloth slightly damp, not wet. Allow enough time for drying and then apply the varnish. The varnish will be dry enough by Monday morning so that the article can be moved elsewhere for storage, but two or three days should be allowed to make sure. The second coat of varnish can be applied on the following Saturday in like manner.

"A book could be written on the subject of varnishing, and many have been written. There are all kinds of right and wrong ways of doing it and the workman can learn only by experience. A good painter can learn very easily; but it is a matter of time and careful training to make a good varnisher out of raw material. No amount of reading 'book rules' will give him what he must get by actual practice. It is a good plan to practice on waste pieces until fairly good results are obtained before this work is attempted on valuable furniture.

"*Rubbing and polishing.*—After the varnishing, if the work is of a high class, it is finished by rubbing and polishing, the rubbing to reduce all the unequal surfaces, the polishing to bring back the gloss to the varnish. The process may be described about as follows: Test the varnish and be sure that it is perfectly dry. This can be done by pressing it with the thumb nail. If no impression can be made, it is dry enough. A pad for rubbing is then used. This pad can be made by wrapping a small wad of cotton waste in a piece of soft cotton cloth. The professional finisher uses a felt pad, but this is difficult to obtain on short notice and the substitute described may be used. The common practice is to dip the pad into oil or water and then into powdered pumice stone. This can be repeated as often as moisture is necessary to pick up the pumice. The pumice is rubbed with the grain of the wood, but care must be taken not to wear off the corners. The rubbing should be continued until the surface presents a uniform appearance. The finest grade of pumice is the best to use, as it is not so likely to scratch the work.

"Polishing is the next step and is omitted if a dull finish is desired.

After rubbing, the surface should at once be thoroughly cleaned. It is usually done by sprinkling the work with damp, soft wood sawdust. The sawdust is dampened to keep from scratching and is wiped off with a soft cloth. Now take a mixture of coconut oil and alcohol in equal quantities to dampen a rubbing pad, and then rub the surface of the wood with a rotary motion until it is polished.

"*French polishing.*—This method of finishing consists of gradually filling up the pores of the wood with a solution of alcohol and shellac and bringing the surface to a high polish by means of rubbing.

"As in varnishing, too much care cannot be given to a proper preparation of the surface that is to be polished. Every little defect must be removed, and every scratch taken off, or the effect will only be to make them more noticeable. About one-half of the entire process consists of the sandpapering. Several grades of sandpaper are used, and when the surface is ready for polishing it is as smooth as glass. Sometimes a filler is used as in varnishing, but the usual way is to start from the raw surface, working in the filler, and bringing the surface to a high polish by the same means.

"The process approved and in use in most of our shops is as follows: After having smoothed the surface with sandpaper, give it a coat of coconut oil. Now use the finest sandpaper, which has already been worn smooth, and rub the surface until dry.

"Make a ball of cotton waste and wrap it in a piece of soft cotton cloth, but be sure that there are no folds or wrinkles in its surface. Wet the ball with alcohol, from the inside, so that the alcohol may soak through. Sprinkle the surface of the wood with powdered pumice stone and rub with a rotary motion until the ball becomes dry. Repeat until the pores are filled. Prepare the shellac as already described under varnishing and put it in a bottle with a tight cork. A small hole may be cut in the cork so that a few drops of shellac can be shaken out at a time. Moisten the inside of the ball with shellac and continue the rubbing until the surface is polished. This will give what is called a natural polish to the wood, as none of the materials used has any color that will affect it.

"The foregoing description gives about all that can be said in the way of directions. In simply reading over the rules, it would appear to be very easy to polish wood, but a practical trial will prove that it is quite the reverse. A great deal of patience is required and the proportion of material necessary has been well described as 5 per cent oil, alcohol, pumice, and shellac, and 95 per cent 'elbow grease.'

"There are many objections to this kind of polishing, the principal one of which is the amount of time required. On the other hand, it is cheap as far as materials are concerned and makes a fine polish. It can be used under circumstances where varnishing is not possible and will be, for many years, the only practicable system we can use in our schools.

"*Staining.*—Cheap work is often stained to look like something better, and so a few suggestions along this line will not be out of place. In the local markets there are several kinds of stains which give satisfaction. The directions for their use are usually printed on the container, and it is not necessary to take up the details in the use of any particular stain. A few general rules that apply to all can be given.

"Stain should always be applied before the filler. It is the next thing in the finishing work after sandpapering. Apply the stain carefully, going over the surface thoroughly, but taking care not to double anywhere, as this will produce streaks in the stain. Most of the common stains or wood dyes are mixed with water, benzine, or alcohol, which 'raise' the grain. It is necessary to allow plenty of time for drying; then the surface can be gone over with fine sandpaper before the next step.

"Most of our stained work is made of lauan or tanguile. This wood, if properly stained, will give a fair imitation of oak or mahogany. The usual object of staining is to make the article match something else in color, or to make the imitation product look like the real one; therefore, a stain should always be selected with care and tested on a sample piece of wood before using. If it is not the right shade it can be thinned to make it lighter or mixed with a darker stain to increase its color. It is not safe to expect that any stain will give quite as deep and rich a color as is shown in the catalogue sent out by the manufacturer.

"*General suggestions.*—In conclusion it is suggested that the filler, varnish, stain, or wax be purchased already prepared whenever possible.

The manufacturers of finishing materials have spent years in perfecting their products and it is folly for an amateur workman to attempt to make his own materials of this kind. Even though he secures the best in the market and does as well as he can, he will not attain perfection. What chance has he when he is using doubtful materials?

"Another good piece of advice is: 'Do not buy cheap material.' The saving of ₱1 in the finish may mean the loss of ₱10 in the sale.

"Above all things, do not waste time in trying to polish inferior work. A good polish will make a piece of furniture attractive, but it cannot cover bad workmanship."

PRESERVATIVE TREATMENT.

In Europe and America the growing scarcity and constantly increasing cost of durable timbers for piling, poles, bridge and wharf building, railroad ties, and mine timbers has led to the adoption on a very large scale of processes intended to prolong the life of the less durable species. There can be no doubt that in the Philippines this will become necessary very soon. In fact, it seems probable that for railroad ties it would even now be profitable to use creosoted or otherwise treated ties of some of the cheaper woods, as these would very probably give longer service than untreated ties of dungon, ipil, molave, and yacal. No extensive experiments have been made in the use of creosoted woods in the Philippines, but it seems certain that where destructive agencies are so much greater than in a temperate climate the advantages of preservative treatment would be correspondingly great. The advantage of using inferior woods creosoted lies not so much in lesser first cost as in the much longer service obtained. The following figures [1] from results obtained by the French Eastern Railway illustrate this point: Untreated oak, creosoted oak, and creosoted beech were used. At the end of twenty-seven years, just 80 per cent of the untreated oak ties had been removed; at twenty-four years, forty-two per cent of the creosoted oak; and at twenty-seven years, only about twenty per cent of the creosoted beech. Now in relative natural durability and first cost the difference between European oak and beech may be compared roughly to that between yacal and apitong or lauan, and the resemblance goes further, for yacal, like oak, would undoubtedly absorb creosote and other preservatives with difficulty, while apitong, possibly, and lauan, probably, would absorb them very easily, thus securing the ideal condition—a deep, even, and thorough penetration of the preservative.

The life of ties is estimated by the Manila Railroad Company as follows: Ipil and yacal with sapwood on edges, three and one-half to four years; heartwood, eight to nine years. Molave ties are generally rendered useless by reboring for resetting track to gauge; it is estimated that if old holes were carefully plugged, they would probably last fifteen years. It seems very probable that apitong, palosapis, and the lauans would, if thoroughly creosoted, outlast untreated ipil and yacal when used for ties. For uses such as sills, posts, poles, bridge and wharf building, where the timbers are not subject to mechanical destruction, the difference in favor of the cheaper softer woods would certainly be still greater.

PROTECTIVE PROCESSES.

All processes for protecting wood against decay, insects, and marine borers fall into two broad classes—superficial and impregnation. Under the first head come painting, varnishing, tarring, sheathing with copper,

[1] From "Seasoning of Timber" by H. von Schrenk, U. S. Department of Agriculture, Bureau of Forestry, Bull. No. 41, 1903.

or covering with a sheath of wire netting or metal lath plastered with cement (a method that has been used to protect piling against marine borers); sometimes poisonous substances, such as arsenical paints, carbolineum, and creosote are used. The efficacy of all superficial treatments depends on having the wood at least partially seasoned and free from incipient decay and on maintaining a perfect covering. If the wood is moist and fungus spores have already obtained entrance to cracks or knot holes, the fungi will grow under the paint or other covering; in fact, the paint may, in such cases, actually do more harm than good by preventing the evaporation of moisture. If, on the other hand, the wood shrinks and checks superficially, or swells and so splits the protective covering, it is again exposed to the entrance of moisture, fungus spores, and insects or marine borers, all of which carry on their destructive work as freely, and sometimes it seems even more freely, under the protective covering than in exposed timbers.

All liquid preservatives are more effective when applied by dipping the wood into the liquid than by applying the liquid with a brush, as in this way the preservative is much more certain to penetrate into all cracks, knot holes, etc., so not only destroying any fungus spores that may already have found lodgement there, but also preventing much more effectively the future entrance of fungi or insects.

All applications of liquid preservatives are best applied to well-seasoned wood, because they penetrate dry wood better than wet and because the wood is not so liable to check subsequently and so expose the interior.

IMPREGNATION PROCESSES.

In impregnation processes, substances more or less poisonous to vegetable and animal organisms are caused to penetrate deeply into the wood. In "nonpressure processes," the capillary action of the wood, or atmospheric pressure, or both, are depended on to introduce the liquid into the interior, while in "pressure processes," the timber is subjected in air-tight steel cylinders to heavy pressures (sometimes as high as 225 pounds per square inch, or 15 atmospheres) to drive the preservatives in.

NONPRESSURE PROCESSES.

One of the oldest nonpressure processes is kyanizing (from J. H. Kyan, who patented the process in England in 1840). In this process the timber is merely soaked in a solution of bichloride of mercury in water. It is evident that the penetration will be the deeper the more thoroughly the wood is previously seasoned.

The principle of practically all other nonpressure processes is to drive out by means of heat the water and air in the wood; as it cools, the air in the wood contracts, forming a partial vacuum, and the pressure of the atmosphere drives the preservative in. Three different methods are used to secure this: (1) Heating the wood in a kiln or oven and transferring it quickly into a bath of the liquid; (2) heating the wood in the bath until ebullition ceases (the sign that at the temperature employed no more air and water can be driven off) and letting the timber and bath cool together, or else draining out the hot bath and filling the tank with a fresh supply of cold liquid; (3) heating the timber as above, and then transferring it quickly to a cold bath. The last method saves time even if applied to separate charges and can be converted into a continuous process by carrying the timber from the hot to the cold bath on chain conveyors.

These methods are most used for impregnation with creosote or other oily substances, but are also employed with solutions in water of zinc and

sodium salts; copper and mercury salts are not used in iron or steel tanks as they attack the iron, unless the tanks and all piping and fittings are specially treated with tar, asphaltum, or similar acid-proof paints.

PRESSURE PROCESSES.

These vary widely both as to the nature of the preservatives used and the methods employed for driving them into the wood. The following is a mere outline of some of the most widely used processes.

Bethell process, or "full-cell creosote process."—The timber, if green, is first subjected to a live-steam bath until the heat has penetrated to the interior of the pieces. Then the steam and air are exhausted from the tank, after which the creosote is run in and forced into the wood by heavy pressure. If the timber is seasoned, the steam bath is not used. This is one of the most effective processes on account of the deep and complete penetration of oil secured by it, but for the same reason one of the most expensive.

Burnett process.—The method of treatment is the same as in the Bethell, but a water solution of zinc chloride is used. This gives excellent results in situations where the timber is not much exposed to water.

The boiling process.—This process, which is extensively used in the Pacific Coast States for impregnating Douglas fir (Oregon pine), differs from the Bethell process in that the timber is boiled in the creosote to drive out the sap, water, and air, after which the temperature is allowed to fall and pressure applied to drive in the oil.

The Lowry process.—This is widely used in the United States for impregnating ties. The object of the process is to obtain a deep penetration with a smaller consumption of preservative. The ties are air seasoned. After placing them in the tank, hot creosote is run in and subjected to heavy pressure. After the wood has taken up the desired amount of oil, a vacuum is drawn and, by the elasticity of the contained air, aided to some extent, probably, by the vapors of the more volatile portions of the creosote, the oil in the cells is driven out, leaving only a coating of oil on the cell walls. This and similar processes are called "empty-cell processes."

The Rueping process.—This is another "empty-cell process." The timber is subjected to a steam and vacuum bath to extract the water. Then air pressure is applied until the cells are filled with compressed air and, on top of this, the creosote is run in at a still higher pressure. When the wood will take no more oil, a vacuum is again drawn and, between the compressed air in the interior and the surrounding vacuum, a large part of the creosote is driven out. This process consumes about half as much creosote per given volume of wood as a full-cell process.

The Rutgers process.—This is much used in Germany for ties. A mixture of about four parts zinc chloride solution and one part creosote is injected by methods similar to those of the Bethell process. The zinc chloride is much cheaper than creosote, but has almost equally good antiseptic properties, while the admixture of creosote prevents the leaching out of the water-soluble salt.

The Card process.—This is extensively used in the United States for ties. The preservative used is practically the same as in the Rutgers process, but the methods of mixing the solution and maintaining the mixture during the various steps of the process are different.

The Wellhouse process.—The preliminary treatment is the same as in burnettizing, zinc chloride being also the preservative employed. After

draining off the zinc-chloride solution, other solutions of glue and tannin are successively forced in, the tannin converting the glue into a leathery, insoluble substance intended to plug the pores and prevent leaching out. Though the process gave good results, it is less used than formerly, largely on account of the complexity of the operations.

The Allardyce process.—The method is similar to the Wellhouse, but creosote is used instead of the glue-tannin combination. The process is not much used now.

The reader desiring more detailed information on the subject of preservative processes is referred to the following works, from which the above data were taken: "Wood Preservation in the United States," by W. F. Sherfesee, U. S. Department of Agriculture, Forest Service, Bull. No. 78, Washington, 1909, and "Preservation of Structural Timber," by Howard F. Weiss, Director Forest Products Laboratory, U. S. Forest Service, New York and London, 1915.

PART III.—USES.

Agricultural machinery and implements. (*See also* HANDLES, VEHICLES, WOODEN TOOLS.)

For framework requiring considerable transverse strength, as well as durability: Anubing, aranga, batitinan, Benguet pine (heartwood), betis, dungon, dungon-late, ipil, lamog, the macaasims, malabayabas, malacadios, malapinggan, malugay, narig, pagatpat, the palomarias, sasalit, sudiang, tambulian, tanglin, tucang-calao and other *Aglaias*, urung, the yacals.

For parts subject to severe wear: Agoho, alupag, aranga, the bacauans, pototans and tangal, bansalagin, betis, binukau and other *Garcinias*, sapwood of bolongeta, camagon, and other *Diospyros* spp., dungon, guijo, calamansanay, liusin, malabayabas, molave, narig, the oaks, sasalit, sudiang, tambulian, the yacals.

For levers, connecting rods, long handles, all rather long or slender working parts requiring straight grained, fairly tough and springy, rather than very strong and very durable woods: Almaciga, banaui and other *Cyclostemons*, batitinan, bayok, bitanhol, sapwood of bolongeta and other *Diospyros*, dalinas, dungon, guijo, lumbayao, malugay, the mangachapuys, narig, the pines, sasalit, the yacals.

Altars. (*See* SCULPTURE AND CARVING.)

Athletic goods. (*See* SPORTING GOODS.)

Automobiles. (*See* VEHICLES.)

Axles. (*See* VEHICLES.)

Backing (mirror and picture frames). (*See* VENEERS.)

Balusters. (*See* STAIRS.)

Bank fixtures. (*See* FIXTURES.)

Barges. (*See* SHIPBUILDING.)

Barrels. (*See* COOPERAGE.)

Beams. (*See* HOUSE CONSTRUCTION and BRIDGE AND WHARF BUILDING.)

Bearings, bushings, brake shoes for vehicles, winches, etc., cogs and cogwheels, pulleys, roller-skate wheels, saw-guide blocks, sheaves, etc.

The following have been used: Alupag (cogs), bansalagin (cogs, bearings), dungon (cogs, brakeshoes), guijo, (brake shoes), mancono (bearings, stern shaft bushings), tangal (cogs). The following are recommended for trial: Agoho, sapwood of camagons (brake shoes, saw guides, roller skates), malabayabas (all uses), narig (roller skates), sasalit (bearings, bushings, brake shoes), sudiang (all uses), tambulian (bearings, pulleys), yacal (brake shoes, cogs, rollerskates, etc.).

Bent-wood articles.

Very little is practically known about Philippine woods for this purpose. Lanutan vehicle shafts are bent by steaming in a crude chest, the wood being used practically green. The Bureau of Prisons has obtained very good results with guijo shafts by boiling them in

Bent-wood articles—Continued.

a tank kept hot by admission of live steam. Gardner states that malugay bends well after steaming. Other woods that would certainly or very probably bend well are: Almaciga, banaui and the other *Cyclostemons,* bayabas, bayok, bitanhol, sapwood of the camagons, dungon (extremely flexible and tough even when dry), kamingi, lumbayao, mangachapuy, pagsahingin, and, where very sharp bends are not required, probably all the lauans.

Billiard cues and tables. (*See* SPORTING GOODS.)

Blinds. (*See* HOUSE CONSTRUCTION.)

Boats. (*See* SHIPBUILDING.)

Bobbins, shuttles, spindles, spools.

Hard, tough, smooth-wearing woods: Bansalagin, sapwood of the camagons, dungon, calamansanay, malabayabas, tangal.

Light, soft woods, for spools requiring smooth texture, but no great strength: Almaciga, balinghasay (pinkish), bangkal (yellow), gubas, the natos (red), malasantol (red), white nato, and all the white or light-red lauans.

Bolsters. (*See* VEHICLES.)

Book cases. (*See* FURNITURE.)

Boot and shoe findings.

Most of the lasts now used in small shops and all of those in the large factories are imported. Lasts have been made on a small scale of various native woods. The following are known to have been used, and are still used, by Manila shoemakers, the first three being considered best in the order given: Bayabas, santol, duhat, manga, banaba, ipil, kamuning, madre-cacao, molave. It is significant of the domestic and very limited character of the industry that the first four are probably the best-known and most widely distributed cultivated fruit trees in the Islands, and one other, madre-cacao, is an introduced species, so that these five are commonest about towns and plantations.

Other species that would furnish close-grained, hard, or moderately hard woods probably well fitted for this purpose are: Agaru, alintatau, aranga, banaui and other *Cyclostemons,* batino, bitanhol, sapwood of bolong-eta and other *Diospyros,* gapasgapas, malasantol, malugay, sablot, tabau, tandu, the white lanutans.

Wooden-shoe soles are extremely common in the Philippines in the clogs called "bakyá" and their manufacture is a considerable local industry in Manila and other centers. The woods used are generally whitish or light colored, rather soft and light, and of fairly straight and even grain. Tuwi is by far the wood used most, at least in Manila, followed by binunga (*Macaranga* spp.), cupang, santol, malasantol, balinghasay, balacat, lanete, calantas, and, in Laguna Province, anabiong (*Trema amboinensis*).

The "corcho" (cork) is a flat-soled, velvet-trimmed slipper with a cork lining about 1 to 1.5 centimeters thick. Its use seems to have been introduced here from Spain, but an excellent substitute for the expensive cork has been found in a sole made of narrow slips of daluru (the air roots or "knees" of pagatpat), pinned together with fine bamboo or hardwood splints and further held together by a thin leather undersole and a cloth insole.

Bowling balls. (*See* SPORTING GOODS.)

Bows. (*See* Sporting Goods.)

Boxes.

Cigarboxes.—For high-grade cigars, only calantas and some imported Spanish cedar are used; for cheaper grades, the lighter colored red lauans, the natos, and sometimes balinghasay and duguan. Malasantol would be equally good, being soft, red or reddish, and possessing a faint pleasant odor not unlike that of calantas.

Clothes chests.—The favorite for both plain and carved chests is narra. No other one wood is used so extensively. For other woods of fine quality, see the lists under "Furniture and Cabinetwork." For the cheap chests that in the Philippines take the place of the ordinary trunk, all the lauans and all the cheap, soft woods commonly found in "miscellaneous lumber" are used, generally stained bright red or yellow and some grained with brown on a yellow ground.

Dry measures.—Dry measures in Manila are made almost exclusively in the form of cubical boxes, ranging from 1 deciliter to 75 liters. All but the two largest sizes are made chiefly of red lauan, but also all other kinds of lauan, palosapis, occasionally apitong, the natos, and any cheap, soft wood the manufacturers happen to find in "miscellaneous lots." The 25-liter and 75-liter measures are almost invariably made of narra of the cheaper grades. These are the only ones having handles, which are usually of apitong, guijo, or yacal and are bolted to the sides.

Jewel boxes.—*See* Sculpture and carving.

Packing cases.—Principally the apitongs and lauans, also some palosapis and (in Zamboanga) very commonly lumbayao, which, while comparatively cheap, is tough and difficult to split. The cigar and cigarette factories use large quantities of packing cases, not only for export, but for provincial shipments. At least one of these factories has a mill at which logs purchased from private loggers are sawn into thin boards for packing cases. They use every kind of cheap, soft wood, excepting some of the excessively soft, brashy kinds, such as dita, kalumpang and other *Sterculias*, taluto, etc.

Packing boxes of a somewhat better grade are made of harder and tougher woods. The Treasury uses, for shipments of coin to provincial treasuries, boxes made of palosapis, apitong, and guijo.

Aside from the tobacco industry, there is no industry consuming any quantity of native lumber for boxes. A very large part of the miscellaneous packing cases used for provincial shipments by Manila commercial houses are remade from American, European, Chinese, and Japanese box lumber in small Chinese and Filipino shops devoted exclusively to this trade.

For packing boxes requiring a light-colored, smooth, tasteless, and odorless wood, easy to work and to nail, the following would be useful: Almaciga, almon, antipolo, bagtican, balacat, dita, gapasgapas, gubas, kalunti, mayapis, pahutan (sapwood), palosapis, putian, white lauan, white nato.

Trunks.—Trunks proper (as distinguished from simple wooden chests) are made only by a few American and Spanish houses in Manila. For the thin boards and slats used in trunks (and in the frames of valises), practically only white lauan has been used; several of the woods named in the preceding paragraph would be just as good.

Crates and veneer fruit packages.—For all purposes not requiring a solid box, crates and baskets of split bamboo and of rattan or other

Boxes—Continued.

climbers are so abundant and cheap that there is little or no demand for light wooden packages of this kind.

Brake beams. (*See* VEHICLES.)

Brake shoes. (*See* BEARINGS.)

Bridge and wharf building.

Piles (*saltwater*).—Agoho, anubing, aranga, the bacauans, bansalagin, batitinan, betis, dungon, liusin (painted or impregnated above tidewater), the macaasims, malabayabas, malacadios, mancono, molave, the pototans, sasalit, sudiang, taba, tabau, tambulian, tiga, urung.

Piles (*fresh-water*).—All the above and agaru, acleng-parang, alupag, alupag-amo, binukau and other *Garcinias*, bitanhol, dugkatan, guyungguyung and other *Cratoxylons*, ipil, the calamansanays, the catmons, kayatau, lamog, malacadios, malapinggan, narig, the oaks, pagatpat, tamayuan, tucang-calao and the other *Aglaias*, the yacals.

Piles (*submerged foundation*).—All kinds straight enough and strong enough to stand driving.

Beams.—Practically all of the above. Liusin should be excluded as being too liable to dry-rot; mancono, on account of its weight and excessive difficulty of working: molave, as being too brittle for long beams; and a few others as being too small or irregular to furnish large-sized saw timber. Where durability is not so necessary or where woodwork is to be creosoted or at least very thoroughly painted or tarred, the following may be used: The apitongs, banaui and other *Cyclostemons*, batete, bayok, binggas, talisay and other *Terminalias*, guijo, the lauans, lumbayao, mangachapuy, the natos, pagsahingin, palosapis, tuai.

Floors.—Where frequent traffic makes mechanical destruction of the planks more rapid than decay, the less durable woods in the last-preceding paragraph may be used or, for greater durability, the same species as for beams.

Broom and brush handles. (*See* HANDLES.)

Brush backs. (*See* NOVELTIES.)

Buckets. (*See* COOPERAGE.)

Buoys and floats.

Of the very light woods a number are cut occasionally for floating rafts of heavier logs, the floaters being sold for any price they will bring; the best known of these are: Banilad and other *Sterculias*, binuang, dita, gubas, cupang, loktob, lumbang, white nato; some of them, if brought to Manila in rafts, can be sold to the match factory, which is probably more profitable than sawing them into lumber. Frequently logs of the heavier woods are rafted with logs of the various lauans and natos; this is more profitable, as lauan and nato bring better prices in the market than the woods above named.

For fishnet and fishline floats and buoys for marking fish traps, dapdap (*Erythrina indica*) and dita are most commonly used; also, in regions where large daluru (pagatpat knees) are found, these are used and are perhaps the best material for the purpose in the Islands. There is no doubt the latter would make an excellent material for life preservers, especially if some means were used to waterproof them, as dipping into paraffin, for example. Also, daluru is recommended as a substitute for cork for lining bottoms of entomological specimen cases and for the small slabs of cork used for thumb tack mounts.

Bushings. (*See* BEARINGS.)

Butcher blocks.

Tropical hardwoods are so often subject to heart checks in large pieces that very few species can be depended upon to furnish sound one-piece blocks. The best blocks now in use in Manila are made of pieces of molave about 15 to 20 centimeters square, held together by two iron bands passing around the outside and bolts passing entirely through from side to side.

Other hard, close-grained, not highly absorbent, and light-colored woods fitted for this purpose are: Agaru, aranga, banaui, sapwood of bolongeta, calamansanay, liusin, malugay, sampalok, yacal.

Cabinetwork. (*See* FURNITURE.)

Canes, umbrella handles, whipstocks.

The prime favorites for canes in the Philippines are undoubtedly ebony and camagon. Next to these probably comes narra. Sticks used rather as weapons of offense and defense than as mere ornament are made of the very hard, heavy, and tough palm woods generally known as "palma brava," or of dungon and similar heavy and strong woods.

Canes of a very black camagon, completely covered with a delicate lacelike carved pattern of lines and scrolls, are made in considerable numbers in some of the northern provinces of Luzon, especially in Vigan and other towns of Ilocos Sur. Lanete is also used for variously carved canes. Bamboo canes are much less used than in other oriental countries, partly due to the comparative scarcity of small-sized bamboos in the Philippines and partly to the fact that the smaller bamboos seem to be much more subject to attacks of borers than those of Japan and China.

Other woods rather frequently or occasionally used for canes are: Agoho, bansalagin, the baticulin family, batitinan, dalinas, ipil, calamansanay, kamuning (highly appreciated), kuyuskuyus, lanutan, mancono, molave, nangka, narra, tamayuan (white, peeled seedlings or sprouts), tindalo.

Practically all of these, as well as a large number of other beautifully colored woods, are available in what, for such small articles as canes, umbrella handles, and riding crops, would be large quantities.

Whipstocks in Manila and the provinces are almost invariably made of rattan, though some wood is used for this purpose also.

Cant hooks. (*See* LEVERS.)

Capstan bars. (*See* LEVERS.)

Cars, electric and railway.

The Manila Electric Railroad and Light Company has used yacal, guijo, and pagatpat for heavy structural parts of cars; pagatpat for outside sheathing; and narra for inside finish and seats. The Manila Railway Company uses chiefly yacal and ipil for framing, as well as for floors, roofs, and siding. The interior finish of their passenger cars is principally Oregon pine.

For interior finish of railway cars in the United States, narra has been used in small quantities and more recently red lauan (imported as "Philippine mahogany"). The following woods are recommended for such work: Acle, apitong, guijo, lumbayao, malugay, mangachapuy, pagatpat, supa, tindalo, toog, and the various lauans.

Carving. (*See* SCULPTURE AND CARVING.)

Casings. (*See* HOUSE CONSTRUCTION.)

Ceilings. (*See* HOUSE CONSTRUCTION.)

Cigar boxes. (*See* BOXES.)

Clubs, police.

Camagon has been used, but proven to be dangerously hard and heavy. The sapwood of camagon and other *Diospyros*, which is lighter, more resilient, and tougher than the heart, would make an excellent club. Other woods recommended are: Agaru, alintatau, amugis, aranga, the bacauans, banaui, batitinan, bayabas, Benguet pine (heartwood), binggas, binukau and other *Garcinias*, dungon, guijo, ipil, calamansanay, kamuning, kuyuskuyus, malapinggan, malatumbaga and other *Aglaias*, malugay, miao, the oaks, palomaria, the pototans, sampalok, supa, tangal, tindalo, urung, yacal.

Coffins.

There is practically no choice exercised in the manufacture of ordinary coffins in either Manila or the provinces, except that only cheap and easily worked woods are used. As all ordinary coffins are either covered with cloth or painted (in Manila very often grained), the appearance of the wood is of no consequence. The comparatively few finely finished coffins used by the wealthier classes are made of red narra and highly polished.

Cogs. (*See* BEARINGS.)

Combs. (*See* NOVELTIES.)

Concrete forms.

For large pieces of work where considerable quantities of lumber of uniform sizes is necessary, the lauans are used; on smaller jobs, cheap miscellaneous lumber of all the softer kinds.

Cooperage.

Buckets, pails, and small tubs are made chiefly of coniferous lumber from American and European packing cases. Large vats for use in distilleries and by wholesale liquor and alcohol dealers are made almost entirely of guijo. In the provinces, where as a rule, the difference of price between higher and lower grade woods is not so great as in Manila, tindalo has been much used for such vats, but in Manila its price is prohibitive. Bilge barrels for liquids are not manufactured. The San Miguel Brewery uses guijo for heading and staves in repairing their imported barrels, the staves being not bent, but shaped. The recently established cement factory is using various lauans for cement barrels.

Corkwoods. (*See* BUOYS.)

Counters. (*See* FIXTURES.)

Crates. (*See* BOXES.)

Croquet sets. (*See* SPORTING GOODS.)

Doors. (*See* HOUSE CONSTRUCTION.)

Dowels. (*See* MOLDINGS AND STICKER WORK.)

Draftsmen's implements.

Practically all such materials are imported. For T-squares, triangles, rulers, curves, etc., an excellent material is the grayish or light reddish sapwood of the camagons, being hard, tough, flexible, and of fine texture. Other woods well fitted for similar work are: Agaru, al-

Draftsmens' implements—Continued.

maciga, alupag, banaui, bansalagin, calamansanay, kayatau, lanutan, malacadios, narig, pagatpat, piagao, supa, tabau, tabigi, tamayuan, tandu, the white lanutans.

For drawing boards, calantas is commonly used; dita is said to have been used for this purpose, but no modern instance is known to the writer; various lauans are also used, of which kalunti and tiaong are the softest; tiaong is of smoother and more homogeneous texture than kalunti. Very similar to tiaong and of even softer texture is the wood of young trees of red lauan.

For triangular and flat scales a dense, light-colored and fairly tough wood is required. The nearest to boxwood among Philippine woods is kamuning, but the brownish mottled color of the heartwood would be objectionable for scales with very fine divisions. Others of almost equally fine and hard texture, but lighter in color are: Agaru, banaui, binukau and other *Garcinias* (those species having little or no red heartwood), kayatau, miao, nangka, the white lanutans.

Scale sticks for lumber scalers, made of almaciga, have recently been put into use. The wood is not as tough and hard as hickory, but it is flexible, light and of very even texture and color.

Meter sticks are made in Manila of narra and guijo, principally the latter, as being comparatively cheap and always to be obtained in every lumber yard.

Dumb-bells. (*See* SPORTING GOODS.)

Engraving blocks. (*See* PRINTING MATERIALS.)

Farm implements. (*See* AGRICULTURAL MACHINERY, HANDLES, VEHICLES.)

Felloes. (*See* VEHICLES.)

Fixtures (bank, office, drug-store, etc.).

For all such work, as for other interior finish and furniture, narra is the prime favorite, the first wood that both the average purchaser and the average contractor think of. However, a number of the other high-grade furniture woods are also frequently used. Among these are: Acle (counters, shelves, show cases, tables, etc.), banuyo (counters, shelves, show cases, tables, etc.), the baticulins (panels and backs of show cases), the camagons (small cases, moldings, various ornamental applications), ipil (counters, tables, show cases), calantas (show cases, paneling, shelves), lanete (small show cases, panels, moldings, various ornamental applications), maranggo (counters, show cases, tables), molave (show cases, counters, tables in drug stores and restaurants), palomaria (show cases, stools, and chairs), supa (counters, tables), tindalo (show cases, tables, chairs, stools).

For medium-grade work the following are much used: Apitong, Benguet pine (only in Mountain Province), guijo, calumpit and other *Terminalias*, the macaasims, mangachapuy, palosapis (often ignorantly or purposely substituted for the higher priced and finer mangachapuy). On account of its abundance, large size, and rich red color, the most-used wood is red lauan. Tanguile is perhaps preferred to red lauan, but is at present much scarcer. Lumbayao is used for about the same grade of work. It is of better quality than red lauan, costs but very little more, but is not so abundant.

For the cheapest grades of store fixtures all sorts of light colored

Fixtures (bank, office, drug-store, etc.)—Continued.

lauans and miscellaneous soft woods are used, very frequently stained red. When obtainable in sufficient quantity, the natos are preferred to most other soft, light woods for shelving, show cases, etc., owing to their comparative freedom from attacks of borers.

Frames (mirror and picture). (*See* MOLDINGS.)

Furniture and cabinetwork.

In the choice of woods for furniture so many elements enter—durability, strength, grain and color, and, last but not least, the matter of price—that it is impossible to make a categorical classification. A rough classification is therefore given under the following heads:

1. Durable and handsome woods, not necessarily abundant, but widely and well known and commonly used: Acle, banuyo, baticulin (paneling, carved and other ornamental work), bolongeta, camagon and other *Diospyros* (molding and borders, turned and carved pillars and table legs, inlaying), ebony (molding and borders, turned and carved pillars and table legs, inlaying), ipil, calantas (panels, lining and shelving for bookcases, wardrobes, map and other filing cases, carved ornamental parts), lanete (panels, moldings, carved and turned pillars, table legs, benches, and stools), narra (all purposes), palomaria (a special favorite for both large and ordinary chairs), supa (tables, sideboards, bookcases), tindalo (all uses, but scarcer than narra and more difficult to work).

2. Woods of same character as above, but scarcer and less known, or else less highly esteemed on account of their less brilliant color, so only used occasionally or rarely: Agaru, acleng-parang (sometimes substituted ignorantly or purposely for acle), alintatau, alupag (scarce and very difficult to work), amugis, banaba, bansalagin, batete (when used, often under name of palomaria), batitinan, binggas, bitanhol (when used, generally under name of palomaria, from which it is difficult to distinguish), calamansanay (scarce and difficult to work), kamatog (very similar to tindalo and sametimes substituted for it), catmon, kayatau, lamog, the macaasims (excellent woods, but inconspicuous in grain and color), malacadios, malatapai (rare and small), malugay, maranggo (equal to calantas, except as to lasting odor), nangka (scarce and small; moldings, inlays, ornaments), pagatpat (only introduced in Manila market in recent years, an excellent and beautiful wood, but not yet widely known), piagao, sudiang, tabigi, tamayuan (scarce, hardly found in Manila market, but used locally), tanglin (unknown in Manila), tucang-calao and all other species of *Aglaia* (all scarce, only tucang-calao found occasionally in Manila market), yacal (abundant, but difficult to work and not of a popular color).

3. Woods of lesser strength and hardness, but abundant, of large size, comparatively cheap, easy to work, and of the most popular color, red; these are practically only three—lumbayao, red lauan, and tanguile, under the latter two names being included all the known and probably some still unknown species of *Shorea* that furnish soft, red woods. The manufacturers of furniture in the popular "mahogany finish" on any considerable scale are practically dependent on these, as the other red woods, such as narra, tindalo, tucang-calao, and many others are either too high-priced or at present too scarce to

Furniture and cabinetwork—Continued.

furnish a large factory with a regular supply. Red lauan, by far the most abundant of the three, is also the wood that has been exported in greatest quantities to the States under the trade name of "Philippine mahogany."

4. Woods of medium price, of fair or good quality, abundant, or at least common, but little esteemed on account of lack of fine grain or color; used for medium-grade furniture, especially for backs, bottoms, shelves, linings, etc., but also for visible parts, frequently stained to various tints of orange or red: Apitong, balinghasay, the bayoks, Benguet pine (all purposes, but only in Mountain Province), dalinsi, guijo, calumpit, mangachapuy, the natos, sacat, talisay, toog, tuai.

5. Cheap, soft, easily worked woods, used for most ordinary kind of furniture: All the light-colored lauans and the lower grades (slash sawn, small sized, wormy, stained, etc.) of the various red lauans, and all of the soft miscellaneous woods commonly or occasionally found in the market, such as: Balacat, banilad and other *Sterculias*, kaliwas, cheap grades of mangachapuy, cheap grades of nato, the pagsahingins, pahutan, cheapest grades of palosapis, tambalau, white nato.

6. A very peculiar specialty in furniture are the one-piece round and rectangular table tops made of the buttress roots of certain trees. By far the largest part of these are of narra; in fact, this is the only species regularly cut for this purpose. The buttress roots of many other species are used for bateas (large, shallow, washbowls, that take the place of the American and European washtub) and for the solid cart wheels formerly used everywhere in the Islands, and occasionally one of these is made into a table top. The writer has seen table tops of guijo, red lauan, mangachapuy, yacal, dao, dungon and cupang, but these are all rare. Dungon and cupang, though formerly much used for wheels, were very rarely made into tables, the former on account of the difficulty of working and surfacing, the later on account of the poor quality of the wood. The largest finished table known to the writer is one of dao, 10 ft. 3 in. (3.12 m.) diameter, belonging to the Philippine Bureau of Forestry.

Golf clubs. (*See* SPORTING GOODS.)

Gymnasium apparatus. (*See* SPORTING GOODS.)

Gun stocks. (*See* SPORTING GOODS.)

Handles. (*See also* LEVERS AND WOODEN TOOLS.)

Handles for adzes, axes, hammers, hatchets, mallets: Agoho (extremely hard, but not springy), banaui and other *Cyclostemons* (hard, smooth, not specially tough), bansalagin (very hard, fairly tough), batitinan (hard, fairly tough), bayabas (hard, fine texture, tough), bitanhol (moderately hard and heavy, tough, difficult to split), sapwood of bolong-eta and camagon (fine, hard, smooth, tough), dalinas (smooth, tough, springy), dungon (fine, hard, extremely tough), guijo (moderately hard to hard, tough, difficult to split), ipil (hard, very stiff), calamansanay (fine, very smooth, difficult to split), lanutan (tough, flexible), malabayabas (very hard, stiff), malugay (moderately heavy, hard, flexible and tough), the pototans (fine, hard, stiff), sasalit (very hard and stiff, but easily split), tanglin (very like ipil), yacal (harder and tougher than guijo).

Handles—Continued.

Handles for mattocks, mauls, picks, etc.: The same list as above.

Handles for brooms, mops, rakes, hoes, and similar tools, requiring a not too heavy, straight-grained, and fairly tough wood: Almaciga, ata-ata and other *Diospyros* having white sapwood, the bayoks, bitanhol, kamingi, lumbayao, malugay, mangachapuy, palosapis, the white lanutans.

Handles for bolos, knives, wrenches, surgical and other professional instruments, handles and butt plates for braces and drills, hollow handle tools, etc., requiring, as a rule, hard, fine-grained woods, difficult to split, but not necessarily tough and flexible: Agaru, agoho, alintatau, alupag, aranga, banaba, banaui, bansalagin, batitinan, bayabas, betis, binggas, binukau and other *Garcinias*, bolong-eta and all other *Diospyros* (both sap and hearthwood), dungon, ebony, ipil, calamansanay, kamuning (the prime favorite for hilts of fighting bolos), kayatau, kuling-manuk and all other *Aglaias*, kuyuskuyus (very similar to kamuning), madre-cacao, malabayabas, malatapai, mancono, miao, molave, nangka, narig, narra, the oaks, pagatpat, pahutan, palomaria, salakin, sasalit, sibucao, sudiang, supa, tamayuan, tangal, tindalo, urung, yacal.

Handles of chisels require a wood that is hard, tough, and especially difficult to split. If provided with a ring at the butt, practically any wood in the above list will make a good chisel handle. For a plain chisel handle, the best of the well-known and common woods is yacal; others are: Batitinan, dungon (better than yacal), calamansanay, palomaria.

Handrails. (*See* STAIR WORK.)

Hat blocks.

Practically only one wood is used by hatters, namely, santol. It is common in and about towns, light, soft, easy to work, not attacked by mold or insects, and not liable to check. A number of other soft woods would serve equally well. As in the case of sculpture, the closest substitute for santol would be malasantol.

House Construction.

1. *Foundation sills, posts, stumps.*[1]—Agaru, acle, acleng-parang, agoho, alupag, anubing, aranga, banaba, bansalagin, batino, batitinan, betis, binukau and other *Garcinias*, dugkatan, dungon, ipil, calamansanay, the katmons, kayatau, lamog, the macaasims, malabayabas, malacadios, malapinggan, malasaging and all other *Aglaias*, mancono, molave, narig, pagatpat, sasalit, sudiang, taba, tabau, tamayuan, tambulian, tiga, tindalo, urung, the yacals.

2. *Posts above stumps.*—Amugis, antipolo, apitong, banaui and all other *Cyclostemons*, batete, the bayoks, Benguet pine, binggas, bitanhol, bolong-eta and other *Diospyros*, guijo, calumpit, kamingi, lago, liusin, malugay, the mangachapuys, the natos, the oaks, the pagsahingins, pahutan, palosapis, the pototans, sacat, talisay, tanglin, toog, tuai, unik, the white lanutans.

3. *Beams, joists, rafters, studding, etc.*—Where considerable strength and especially great durability are required, the woods used for sills and posts should be employed; for situations thoroughly protected

[1] A common practice is to put in the ground short "stumps" or stubs of durable woods, to which, a meter or two above the ground, are spliced posts of cheaper and less durable woods.

House construction—Continued.

from weather and at a sufficient distance from the ground, the woods specified for "Posts above Stumps" may be used; and, finally, for light or temporary work, all the lauans and the following: Almaciga, balacat, binuang, kaliwas, kalumpang, and other *Sterculias*, cupang, loktob, malakalumpang, cheap grades of nato, tambalau, white nato.

4. *Flooring.*—For high-grade work, requiring durability, beauty of color and grain, and capacity for taking and retaining a fine finish: Agaru, acle, acleng-parang, amugis, aranga, bacauan, banaba, banuyo, batitinan, ipil, calamansanay, kamatog, the catmons, lamog, malacadios, malugay, the harder grades of mangachapuy, manggis, molave, narig, narra, the oaks, pagatpat, palomaria, sudiang, supa, tanglin, tindalo, tucang-calao and other *Aglaias*, the yacals.

Cheaper woods or less well-known woods capable of taking and retaining a good finish: Apitong, banaui and all other *Cyclostemons*, batete, bayok, binggas, dao, guijo, guijo-blanco, the catmons, kato, lumbayao, miao, palosapis, the pototans, talisay, and the other *Terminalias*, tandu, the hardest grades of tanguile, tuai.

For floors subject to heavy and rough usage, yacal is undoubtedly the best of the abundant woods; next to this, guijo and the hardest grades of apitong; the bacauans, from their hardness, density, and durability would, if properly sawn and seasoned, make a superior flooring for stores and public buildings

5. *Siding.*—Where exposed to the weather or near the ground and unpainted, the following may be used: Agaru, alintatau, anubing, aranga, banaba, batino, batitinan, betis, binukau and other *Garcinias*, ipil, calamansanay, the catmons, lamog, the macaasims, malacadios, molave, narig, narra, pagatpat,[1] sudiang, tabau, tamayuan, tambulian, tanglin, tindalo, tucang-calao and all other *Aglaias*, the yacals.

Where protected, or well painted, the following: Almaciga, amamanit, apitong, balinghasay, banaui and other *Cyclostemons*, bangkal, batete, bayok, Benguet pine, binggas, binuang, gapasgapas, guijo, calumpit, cupang, all the lauans, lumbayao, malasantol, malugay, the mangachapuys, the natos, the oaks, the pagsahingins, palosapis, sacat, salingkugi, talisay, tandu, tuai, unik, the white lanutans.

6. *Sheathing, ceiling, paneling.*—The chief requisite of a good wood for this purpose, aside from beauty of grain and color, is freedom from attacks of borers; also comparatively light, soft woods are naturally preferred, especially where a large part of the preparation is handwork. For these reasons the following are favorites: Antipolo, bangkal, banuyo, the baticulins, calantas, lumbayao, malasantol, mangachapuy, maranggo, the natos, santol; the lauans are also much used, but they are not so free from insect attacks as most of the above. For high-grade sheathing and paneling, narra is the prime favorite, the following being also used: Acle, amugis, aranga, batitinan, ipil, malacadios, molave, pagatpat, sudiang, supa, tindalo. Other beautiful woods of excellent quality, but rarely used on account of their relative scarcity or very limited distribution, are: Agaru, acleng-parang, alintatau, banaba, batino, cañafistula, calamansanay, kamatog, the catmons, malambingan, malugay, manggis, palomaria, piagau, tabigi, tamayuan, tanglin, tucang-calao, and all other *Aglaias*.

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[1] Pagatpat siding exposed to weather must be fastened with wooden pins, copper nails, or, at least, with large steel nails, as it will rust out small steel nails very rapidly.

House construction—Continued.

7. *Window sills.*[1]—The favorite and best-known woods for this purpose are: Aranga, bansalagin, batitinan, ipil, calamansanay, macaasim, molave, yacal. Others of equally good quality, but scarcer, are: Agoho, alupag, banaba, binukau and other *Garcinias,* madre-cacao, malabayabas, narig, pagatpat, sasalit, sudiang, taba, tamayuan, tiga, tucang-calao and all other *Aglaias,* urung. For cheaper work the apitongs and guijo are most used, being fairly hard and tough and also somewhat more durable than the lauans and other soft woods.

8. *Windows.*—Among the durable woods, by far the most widely used for this purpose are molave and yacal; in high-class work, narra is also often used; locally, the most durable woods known in any given region are used; the amount of wood necessary for this use being small, scarcity is not so great a bar as for other purposes, a log or two being enough to furnish all the windows for an average house. Practically all the durable woods above listed under "Window sills" are occasionally used for windows. For cheaper work, the apitongs, guijo, palosapis, and even the lauans are used, all of these, of course, requiring thorough painting if they are to last more than a few years.

9. *Blinds.*—Outside blinds or shutters are practically unknown in the Philippines, except as removable boards to close shop doors and windows; but inside blinds, sliding like the windows on the sill, are an almost universal feature of all but the cheapest houses. Sometimes they have solid panels, but much more commonly they are made with louvre slats. For both frame and slats, narra is the commonest material for high-class work. Sometimes the frame is made of molave or yacal, with slats of narra or other ornamental woods. Beside those named, practically every wood used for any kind of interior finish is used also for blinds, the choice depending on the taste and means of the owner.

10. *Doors.*—Acle, molave, narra, and tindalo are used more than any other woods for high-grade work; less commonly amugis, banuyo, batete, ipil, malacadios, pagatpat, sudiang, and supa; cheaper, but very substantial and handsome, doors are made of apitong, guijo, lumbayao, palosapis, and tanguile, while the best grades of red lauan have also been used recently for finely finished work.

Household implements.

Bowls.—From the huge shallow "bateas" used as washtubs down to various flat or round bottomed dishes used in the house, the majority are made from buttress roots; narra, cupang, dao, and several different lauans usually furnish these roots. Many of the smaller bowls, dishes, and plates (up to 40 or 50 centimeters in diameter) are made of blocks sawn or split from the trunk itself. For this purpose the natos are favorites; but for small bowls not subject to rough usage even so soft a wood as dita is sometimes used. Small bowls of narra, tindalo, and other pretty woods are often purchased by Americans and other foreigners and polished for use as card trays, etc.

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[1] The window sill, in Philippine construction, is not a mere adjunct or piece of trim, but is an essential structural part of the house framing, running from corner post to corner post, supporting the whole weight of the heavy sliding windows, that often occupy more than three-fourths of the side of a room, and itself supported by studding, turned pillars, or by vertical siding running from window sill to floor level. For these reasons it requires woods that are strong and resistant both to the weather and mechanical abrasion.

Household implements—Continued.

Ladles and spoons.—The favorite material for such articles is lanete. Occasionally salad forks and spoons of kamuning are seen, and molave is also so used.

Mortars and pestles.—The rice mortar with from one to three holes is indispensable in every house outside the towns, the rice in the country being stored in the hull and the daily ration hulled by pounding in a mortar. Molave, on account of its hardness, durability, and comparative ease of working, is naturally a favorite for this purpose; other woods known to be used are alintatau, alupag, anislag, balinghasay, banaba, banaui and other *Cyclostemons*, bayok, duhat, guijo, calamansanay, kamingi, the macaasims, malapinggan, the oaks, palo-maria, sampalok, sasalit. Beside these, the lauans and many other soft woods are used. For the small mortars used for pounding betel-nut paste, etc., sapwood of camagon and other *Diospyros* and similar very dense, hard woods are often used.

For pestles, the following are known to be used: Alupag, aranga, the bacauans, bansalagin, sapwood of bolong-eta and other *Diospyros*, hambabalud, calamansanay, tamayuan, the oaks, the pototans, tangal, tiga.

Rice mills.—For the framework of the domestic rice mill (for blanching or polishing the rice) bamboo and various soft, easily worked woods are used. In only one part is a special wood required, namely, the burrs, which are made of narrow strips of wood set in a cement on the surface of a disk, so as to form a pattern like that of the burrs in a millstone. For this, one of the best-known woods is alupag, but palma brava is also extensively used. No doubt many other woods are used in various regions. A list of the woods fitted for such work is given under "Bearings."

Hubs. (*See* VEHICLES.)

Indian clubs. (*See* SPORTING GOODS.)

Interior finish. (*See* HOUSE CONSTRUCTION.)

Joists. (*See* HOUSE CONSTRUCTION.)

Kitchen ware. (*See* HOUSEHOLD IMPLEMENTS.)

Ladders.

Very few ladders are made of wood in the Philippines, where bamboo is almost universally available. Temporary ladders on building jobs are knocked together of any fairly light material that may be handy. For sides, the following are recommended: Almaciga, almon, bagtican, bayok, guijo (rather heavy, but very strong), lumbayao, malugay (rather heavy, but very strong), mangachapuy, pine, red lauan, tanguile, the white lanutans, white lauan. Most of these, if exposed to weather, should be thoroughly painted. For flat rungs, the same woods may be used; for round rungs requiring a stronger wood, the following: Aranga, the bacauans, bansalagin (very hard, strong, and durable), batitinan, bayabas, binukau and other *Garcinias*, bitanhol, sapwood of bolong-eta and other *Diospyros*, dungon (probably the best wood in the Islands for this purpose), guijo, ipil, lanutan, malabayabas, malugay, narig, the oaks, sasalit, tangal, yacal.

Levers.

Under this head may be conveniently grouped cant hooks and peavies, capstan bars, handspikes, and similar large and heavy tools

Levers—Continued.

or handles requiring hard and tough woods. The woods most commonly used for such purposes are: Alupag, the bacauans, bansalagin, bayabas (rarely large and straight enough for large pieces, but a favorite for small levers), bitanhol, sapwood of bolong-eta and other *Diospyros*, dungoń, guijo, ipil, narig, yacal. Others equally good, but less well known, are: Banaui and other *Cyclostemons*, dalinas, lamog, malabayabas, malugay, sasalit, sudiang, taba, tiga.

Life preservers. (*See* BUOYS AND FLOATS.)

Lighters. (*See* SHIPBUILDING.)

Masts. (*See* SHIPBUILDING.)

Matches.

The woods most used at present, both for match sticks and for boxes, are gubas, malapapaya, and taluto. Pinkapinkahan has been used, but is small and scarce; white lauan has also been cut occasionally, but is not as good as the above named. For some time lumbang was used to a considerable extent, but the supply came chiefly from old plantations and was soon exhausted. White nato, as far as known, has not been used, but is recommended for trial. If the prejudice against dark woods could be overcome, a large supply of the softer grades of the natos and of tiaong would be available. The latter is the finest and straightest grained of the lauans.

Measures. (*See* BOXES.)

Mine timbers. (*See* TIES AND MINE TIMBERS.)

Mirror backs (hand). (*See* NOVELTIES.)

Mirror backing. (*See* VENEERS.)

Mirror frames. (*See* MOLDINGS.)

Moldings and sticker work.

No manufacture of moldings as a separate industry exists in Manila. The larger furniture factories and planing mills use machinery to supply their own needs and to fill special orders; the smaller shops buy from these or work out small lots by hand for each individual job. In interior finish very few moldings, and these of very simple design, are used. For such, the same woods are naturally employed as for the remaining inside finish. (*See* House Construction; Sheathing; Ceiling; and Paneling.)

Picture and mirror frames.—These are made mostly of imported gilt or otherwise finished moldings. The native industry in frames tends much more to variety of outline and carved ornament than to the use of straight line moldings. (*See* Sculpture and Carving.)

The flat moldings used for electrical wiring are almost always of white lauan or almon, variously stained and painted to harmonize with the interior finish.

Dowels for doors, windows, and furniture are most commonly made of guijo, which is tough and difficult to split. Where used for construction to be exposed to the weather, they should be made of ipil or yacal.

Rolling porch and window screens are made of strips about 0.5 by 2 centimeters of white lauan, both the wood strips and the cords with which they are tied being heavily painted. Probably no other equally light wood is as well fitted for this purpose.

Mortars. (*See* HOUSEHOLD IMPLEMENTS.)

Mudguards. (*See* VEHICLES.)

Musical instruments.

At least 95 per cent of the musical instruments made in the Philippines are guitars, mandolins, and bandurias. Beside these, a few harps are made in Manila and one firm manufactured piano cases for some years.

The thin lumber for the instruments of the guitar family is sawn by hand from boards or small logs. As a general rule, the back and sides of an instrument are made of the same wood, the back being almost invariably made of two adjacent leaves of veneer opened out and jointed so that the grain makes a symetrical figure. The following are the woods used for the various parts.

Backs and sides.—Most commonly banuyo, the camagons, calantas, lanutan, malatinta, nangka, narra; less commonly acle, amugis, antipolo, balinghasay, balu, banaba, banalo (rare), bitanhol, dao, catmon, lamio, lanete, pagatpat.

Sounding boards.—Almost invariably of American or European coniferous box lumber. In Ilocos Sur, Benguet pine is sometimes used.

Necks.—Lanete for the great majority; more rarely amugis, apitong, balinghasay, lago, various lauans, palosapis, santol.

Heads.—The head is not, as in a violin, carved in one piece with the neck, but made of a separate piece (generally of the same wood as the neck) attached at an angle by a lapped or dovetailed joint; over this is glued a piece of the same thickness as the upper end of the fingerboard and almost always of the same wood as the back and sides.

Finger boards.—Bolong-eta, camagon, ebony, or malatinta are the most used; less commonly dao, dungon, ipil, supa.

Keys, tailpieces.—Camagon, ebony; less commonly, dungon, narra.

Trimmings.—The very narrow strip inlaid around the edges is almost invariably of lanete, though sometimes rattan is used. Inlaid ornaments on back or sounding board are generally of the various camagons, ebony, or red narra; tortoise shell, mother of pearl, and metals are also used for inlays.

Interior reënforcement.—The cross battens of the back are generally of coniferous box lumber or lanete; very narrow strips of rattan are glued along the joints as reënforcement.

Harps are made only in very small numbers and to order, but the woods used are very uniform.

Base.—Not built up, but shaped of a solid block, generally apitong or some similar cheap, fairly hard wood. Duhat is also used.

Back and sides of body.—Banuyo, nangka, lauan, palosapis, the latter two generally stained red.

Sound board.—Coniferous box lumber.

Pillar.—Apitong (black finish), narra (natural finish).

Wrest plate.—Amugis, dungon, narra.

In the piano cases manufactured in Manila only calantas was used, both for the outside, the sounding board, and all the inside fittings, such as pedal rods, etc. The manufacture has been discontinued, as the product could not compete in price with imported pianos. In

Musical instruments—Continued.

repair work, local shops use chiefly acle, antipolo, banuyo, dungon, calantas, narra, and tindalo—all being woods not attacked by borers. In Europe and America small quantities of acle, lumbayao, narra, and tindalo have been used for piano cases. All of the following are woods of good quality and of great beauty that could be obtained in fair or large quantities: acle, banuyo, batete, batitinan, ipil, calamansanay, calantas, lumbayao, malugay, maranggo, narra, pagatpat, red lauan, supa, tanguile, tiaong, tindalo.

Newels. (*See* Stair Work.)

Novelties.

Desk supplies, such as paper weights, inkstands, pen and pin trays, etc., for which hard, heavy, and dense woods of striking color are in demand: Agaru, acle, agoho, alupag, aranga, bacauan, bansalagin, bolong-eta, camagon and other *Diospyros*, ebony, calamansanay, kamuning, catmon, lamog, malabayabas, malasaging and all other *Aglaias*, malatapai, mancono, molave, narra, pagatpat, pahutan, palomaria, sasalit, sibucao, sudiang, tamayuan, tangal, tindalo.

For mirror and brush backs and similar toilet articles, most of the above would make fine material. In this connection, it may be remarked that both the streaky heartwood and the red sapwood of bolong-eta and camagon take black stains very well, the latter having, moreover, the advantage over the black or streaky heartwoods of the ebony family of being tougher and less liable to check.

Combs.—The commonest form of comb made in the Islands is a segment of a circle, somewhat less than a centimeter thick in the middle of the curved back and tapering to a thin edge. The teeth are cut with a fine saw and the edges scraped smooth. For these combs the favorite material is camagon; both heartwood and sapwood are used; other woods are only used very occasionally, alupag being one of the best.

Toothpicks.—These, handmade of course, are generally made of bayabas and gumamela (*Hibiscus rosa-sinensis*). An excellent material for machine-made toothpicks would be almaciga. Bamboo is much used in Manila.

Oars. (*See* Shipbuilding.)

Office fixtures. (*See* Fixtures.)

Paddles. (*See* Shipbuilding.)

Paving blocks.

The following have been the most used and with the best results: Molave, dungon, ipil, agoho, aranga, pagatpat, yacal. The following would make good blocks without treatment: anubing, betis, binukau and other *Garcinias*, the macaasims, sudiang, urung. The following are recommended for treated blocks: Apitong, bacauan, banaui and other *Cyclostemons*, guijo, catmon, liusin, malugay, the oaks, the pagsahingins, palosapis, the pototans, tandu, tuai. Where the traffic is not excessively severe, the lauans, lumbayao, and the natos could be used, especially as they would probably all absorb preservatives very well.

Piling. (*See* Bridge and Wharf Building.)

Poles. (*See* Vehicles.)

Poles, telephone and trolley.

Practically the only wood that has been used very extensively for this purpose in Manila is ipil. The following would also make good poles (those marked *s* should be free of sapwood; the others may be used with sapwood): Acleng-parang (s), agoho, alupag, anubing (s), aranga, batitinan (s) binukau and other *Garcinias*, dungon and dungon-late (s), calamansanay, lamog, the macaasims (s), malabayabas, malapinggan, narig (s), pagatpat, sudyang, taba, tabau, tamayuan (s), tambulian, tiga, tucang-calao and all other *Aglaias*, urung, the yacals.

Posts. (*See* HOUSE CONSTRUCTION.)

Posts, fence.

All the woods listed under "Poles" and also the following, which, though rarely tall and straight enough to furnish poles, are strong and durable: Agaru, anislag, antipolo, banaba, bansalagin, batino, betis, caña-fistula, dugkatan, guyungguyung and other *Cratoxylons*, the catmons, kayatau, kulasi, madre-cacao, malacadios, the oaks, sasalit, tangal.

For creosoted fence posts: Api-api, apitong, balacat, banaui and the other *Cyclostemons*, batete, the bayoks, Benguet pine, guijo, kaliwas, calumpit, kamingi, cupang, lago, lamio, all lauans, liusin, lumbayao, malacalumpit, malanangka, malasantol, malugay, the natos, the pagsahingins, palosapis, sacat, talisay, tambalau, tandu, toog, tuai, the white lanutans, white nato.

Printer's materials.

Engraving blocks.—The wood most closely resembling boxwood is kamuning. It is probably little, if at all, inferior to boxwood for this purpose. Like boxwood, it requires very slow and careful seasoning to produce blocks absolutely free from checks. Molave has also been used; though not so tough, dense, and hard as kamuning, it is of very fine texture and works beautifully with fine, sharp tools. Calamansanay is of as fine or even finer texture than molave and is tougher and denser. Bayabas, a fine grained, tough wood, is said also to have been used for engraving. Other hard, dense, tough, and light colored woods recommended for trial are: Agaru, ata-ata (sapwood), banaui and the other *Cyclostemons*, bolong-eta and camagon (sapwood), narig, sasalit.

For wooden type, as the process of engraving is much simpler, light color is not so necessary as for fine engravings, so that for this purpose, beside the above, a number of other very hard, dense woods are available, such as: Agoho, alupag, the bacauans, bansalagin, betis, dungon, malabayabas, sudiang, supa, taba, tangal, tiga, the yacals.

For electrotype blocks a wood is required that is not liable to shrink, swell, or warp when thoroughly seasoned, soft enough to take small nails easily, but not liable to check or to sliver around the edges. Such are: Almaciga, balinghasay, bangkal, bayok, kayatau, malacadios, malasantol, malugay, mangachapuy, the natos, pagatpat, piagao, tabau, tabigi, tandu, tanguile.

Quoins require wood smooth, hard, tough, and difficult to split. Such are: Agoho, sapwood of bolong-eta and camagon, dungon, calamansanay, malabayabas, sampalok, sudiang, the yacals.

Pyrography.

For this the chief requirements are homogeneous texture and even, light color. The following are recommended: Almaciga, banaibanai, baticulin, batino, gapasgapas, gubas, lanete, miao, putian, white nato.

Rafters. (*See* House Construction.)

Reaches. (*See* Vehicles.)

Risers. (*See* Stair Work.)

Saw-guide blocks. (*See* Bearings.)

Screws. (*See* Wooden Tools.)

Sculpture, carving, and inlaying.

By far the most important single feature of sculpture in the Philippines is the making of sacred images. The favorite woods for these are the yellow baticulins produced by various trees of the family *Lauraceae*. (See Part V, p. 107.) Where this is not available, santol or lanete are used, the choice between these two depending on the local supply, prices, or the prejudices of the sculptor and the purchaser. Calantas is used occasionally; like all of the foregoing, it is easy to work and insect proof, but is less liked on account of its irregular open grain. For cheaper work, marang and other white baticulins are used and occasionally manggasinoro, red lauan, and tanguile.

For statues to be permanently set up outdoors, molave is the first choice and ipil second. Baticulin and other soft woods are sometimes used, but these need to be painted annually to preserve them for any length of time.

Pedestals and the platforms (Sp. "andas") on which statues of saints are carried in processions are made of banuyo, narra, acle, or, for cheaper work, of red or white lauan. Baticulin and santol are also used and, for stationary pedestals in which weight is not an objection, molave. For moldings, carved ornaments, raised plain or carved panels, etc., the same woods are used.

Both statues and pedestals or platforms are, as a rule, painted more or less artistically, but pedestals for permanent indoor installation are often varnished in natural colors, in which case different woods are used to produce varied color effects.

Altars and other ornamental or ornamented fixtures in churches are generally of the best and most beautiful wood. Narra, acle, and tindalo are favorites. Carved and turned ornaments, especially where subject to wear, are often of molave, but, where strength is not essential, baticulin, lanete, and santol are favorites. In some regions, bangkal is used as a substitute for these; it is soft, works very smoothly, and is rarely attacked by insects.

For benches and for posts and handrails of partition railings in churches, all articles subject to much handling and wear, often more or less ornamented with carvings, tindalo and molave are favorites.

Chests and jewel boxes.—A special industry in certain regions is the manufacture of chests ornamented with a flat design executed by the method of chip carving (German, "Kerbschnitzerei"); all four sides and the top are completely covered, except a narrow plain border, with the carving. In the larger sizes these are made invariably of narra, smaller ones of narra or lanete. The chief seat of this industry is in Ilocos Sur. In the same region are made also very beautiful jewel boxes of a specially dark camagon, completely covered with a very fine, lacelike design of scrolls and arabesques. Canes carved in the same style are also made there.

Picture frames.—These are made in the Manila sculptor's shops in probably greater numbers than any one other article. A very large proportion of them are of banuyo, a very pretty, durable, and easily

Sculpture, carving, and inlaying—Continued.

worked wood. Other woods commonly used are: Acle, bolong-eta, camagon and other *Diospyros* (the strongly contrasting heartwood and sapwood sometimes used to produce very striking effects), tindalo, molave, and the ubiquitous narra. Other woods occasionally used are amugis, the yellow baticulins, calantas, lanete, lanutan, and tanguile; and for very ordinary work, apitong, the lauans, and palosapis, the latter generally called mangachapuy.

The favorite designs have outlines reminding one of the bold curves and arabesques used in outlines of poster designs. Additional ornamentation is of two distinct kinds: Incised carving of scrolls, arabesques, basket weave patterns, and leaves, flowers, etc., or ornaments carved in low or high relief and glued onto the flat surface of the frame. These ornaments are generally made of wood contrasting as strongly as possible with that of the frame. Lanete is the favorite, but the baticulins, molave, and santol are also used, and sometimes dark-colored woods, such as red narra and acle.

The sculptor's shops do a great deal of job work for other trades, such as carved feet, panels, pillars, finials, etc., for furniture; carved capitals for pillars of harps; carved letters and ornaments for makers of showcases and signs. For such work all the above woods are used, as well as many others, the choice often depending on the caprice of the owner of the work, who sometimes furnishes the wood himself.

Inlaying.—Small tables, cabinets, china closets, desks, wardrobes, etc., are often elaborately inlaid with woods of various colors. Favorites for such work are: Whitish or yellowish—alintatau, the baticulins, kamuning, lanete, molave, nangka; red—calantas, malasaging and other *Aglaias*, narra, sibucao, tindalo; brown—banuyo, catmon, acle; black—bolong-eta, camagon, ebony.

Shafts. (*See* VEHICLES.)

Shades, porch and window. (*See* MOLDINGS AND STICKER WORK.)

Sheaves. (*See* BEARINGS.)

Shipbuilding.

Cabin work.—For the highest grade work narra, and sometimes tindalo, are used. Equally good, but less often used, are acle, amugis, banuyo, batitinan, ipil, calantas (ceilings and panelings), malugay, pagatpat, palomaria. Where cheaper wood of good quality, but with less beauty of grain and color, is required, guijo and mangachapuy are used. Still cheaper, not quite so hard, but durable and of better appearance, is lumbayao. A good grade of red lauan is almost equally good. For the cheapest work, all the lauans, sometimes nato, and miscellaneous soft woods are used.

Keels.—The following are most commonly used: Dungon, guijo, molave (small vessels), the yacals; less commonly, anubing, aranga, bansalagin, batitinan, betis, pagatpat, palomaria. Liusin and tambulian are recommended on account of their resistance to teredo.

Knees and ribs.—The following are known to be used: Dungon, molave, palomaria, tangal. Knees are either made of natural crooks or sawn out of planks. In the latter case, curved logs, especially of molave, are often sawn into thick planks parallel to the plane of curvature and the ribs then sawn out approximately along the curvature of the grain.

Masts and spars.—Bitanhol and mangachapuy are the best-known

Shipbuilding—Continued.

woods for this purpose. Both are tough and springy, durable when not in contact with the ground, and not excessively heavy. For small spars, guijo and various lauans are used, also slender saplings of the bacauan family. Lumbayao and malugay are tough, straight woods that would make good material for masts or small spars, but are rather heavy for large spars. Probably the best wood in the Islands for spars would be almaciga, though it is not kown to have been used, probably on account of its inaccessibility.

Planking.—Commonly used for both decks and hulls—guijo, mangachapuy, the yacals; well known, but less used—batitinan, bitanhol, pagatpat; specially recommended for decking on account of their hardness and durability—narig, tambulian, the yacals; much used for cheaper work—apitong, the lauans, palosapis; used for small sailing vessels—lumbayao (in Mindanao), malugay (in Mindoro).

Treenails.—Bacauan, bansalagin, sibucao, and tangal are favorites, on account of their straight grain, smooth texture, hardness, and durability. Other hard, durable, and straight-grained woods are narig, sasalit, and tamayuan. In Manila, guijo and yacal are used; being cross-grained, they must be sawn into small squares and then rounded by hand or run through a sticker. Other excellent woods that would have to be shaped in this way are: Agoho, batitinan, dungon, ipil, kalamansanay, malabayabas, oak, sudiang, tambulian.

Ship's wheels.—The favorite woods are bansalagin and dungon, the former being preferred for its smooth wearing quality.

Dugouts or bancas.—The lauans, being large, light, and easy to work, are naturally most used for this purpose. Calantas, where available, is highly appreciated on account of its durability. Other woods used in various localities are: Antipolo, binuang, dao, cupang, loktob, lumbayao, malabog, marang, nato, tanguile.

Barges, lighters, scows.—Yacal and guijo are the woods most commonly used for keels, ribs, gunnels, and other heavy parts, and guijo for bottoms and sides. Where economy is the first consideration, palosapis, white lauan, and other lauans are used for planking.

Oars and paddles.—For paddles every easily worked wood from white lauan to molave is used, the former representing the minimum of weight combined with least requirements of strength and durability in an oar and the latter the maximum convenient weight with the greatest durability. For ship's boat oars, guijo and mangachapuy are used. Malugay would undoubtedly make an excellent oar. For light sculls, spoon oars, and canoe paddles, almaciga would be equal, if not superior, to spruce.

Shoe lasts. (*See* BOOT AND SHOE FINDINGS.)

Shoe soles. (*See* BOOT AND SHOE FINDINGS.)

Show cases. (*See* FIXTURES.)

Shuttles. (*See* BOBBINS.)

Siding. (*See* HOUSE CONSTRUCTION.)

Sills. (*See* HOUSE CONSTRUCTION.)

Singletrees. (*See* VEHICLES.)

Spars. (*See* SHIPBUILDING.)

Spindles. (*See* BOBBINS, ETC.)

Spokes. (*See* VEHICLES.)

Spools. (*See* BOBBINS, ETC.)

Sporting and athletic goods.

Bars, horizontal, parallel, trapeze, etc.—Requiring tough, smooth woods: Agoho, bitanhol, bansalagin, batitinan, bayabas, sapwood of bolong-eta and camagon, dalinas, dungon, malabayabas, malugay, narig, sasalit, the white lanutans, the yacals.

Billiard cues.—Excellent shafts for billiard cues have been made of guijo and palosapis, with butts of narra, camagon, and tindalo. Other straight-grained woods recommended for shafts are: Agaru, almaciga, aranga, sapwood of ata-ata, bolong-eta, camagon and other *Diospyros*, banaui, batitinan, bayok, bitanhol, lanutan, lumbayao, malugay, manga-chapuy, pagatpat, supa, the white lanutans.

Billiard tables.—High-grade billiard tables made in Manila are practically all of narra, the cheaper ones of red lauan and tanguile. The writer knows of one beautifully finished table of batete. For other woods suited for the purpose, see "Fixtures and Furniture."

Bowling alleys.—The few bowling alleys in Manila, in provincial capitals, and at military posts are all imported. The following would make excellent material for this purpose, being hard, tough, fine-grained, and of light color: Aranga, banaui, binukau, sapwood of bolong-eta and camagon, calamansanay, malugay, and yacal.

Bowling balls.—Dungon and mancono have been used. Mancono is practically equal to lignum-vitæ. Dungon is even tougher and more difficult to split than mancono, but is not as heavy.

Bows.—The best material for bows in the Islands is palm wood (Span., "palma brava"); it is very hard and tough and much more resilient than any of the other hard and tough timbers. It is the favorite material for this purpose of all the primitive hill folk.

Croquet sets.—There is practically no doubt that for combined weight, hardness, and toughness, dungon is the best material for both mallets and balls. For the balls alone, mancono would be superior to dungon. Other woods, less heavy, but otherwise fit for croquet balls and mallets, are: Agoho, betis, sapwood of the camagons, calamansa-nay, malabayabas, malasaging and other *Aglaias*, palomaria, sampalok, yacal.

Dumb-bells.—Approximately in the order of their weights, the following, all hard, heavy, woods capable of taking a fine polish: Mancono, camagon, alupag, sasalit, aranga, dungon, bansalagin, narig, yakal, agoho, malabayabas, calamansanay, tindalo, ipil, molave. Lighter woods suitable for the purpose are: Almaciga, bangkal, bitaog, guijo, lumbayao, malugay, nato, palosapis, tanguile, tucang-calao, tuwi, and white lauan.

Fishing rods.—For this, as for bows, the best known material is palm wood.

Golf clubs.—The sapwood of the camagons is practically identical with persimmon, which in America is used more than any other one wood for golf-club heads; other woods that are heavy, tough, and difficult to split are: Dungon, guijo, calamansanay, malugay, palomaria, sampalok, the yacals. For the shafts, dungon, lanutan, and malugay are recommended; if it does not prove too heavy, palm wood would make an excellent shaft.

Gunstocks.—Acle, camagon, lanutan, and narra are used by gun-smiths in Manila. Acle, acleng-parang, and pahutan are the woods that most closely resemble black walnut in color and texture. Guijo

Sporting and athletic goods—Continued.

has been tried also; it undoubtedly makes an excellent stock, but on account of its insignificant grain and color is not likely to become a favorite. Other good woods for this purpose are apitong, banaba, banuyo, batitinan, binukau and other *Garcinias*, bitanhol, calamansanay, lumbayao, malugay, palomaria, piagao, sampalok, sudiang, supa, tucang-calao and all other *Aglaias*.

Guijo has been used with satisfactory results by the military authorities for the wooden guns used for bayonet-fighting practice.

Indian clubs.—For this purpose lighter woods are generally used than for dumb-bells. For very light clubs, baticulin, calantas, and the lauans would make good material. Somewhat heavier woods are: Amugis, apitong, banaba, banaui, banuyo, batete, bayok, bitanhol, guijo, lumbayao, narra, the natos, pagatpat, palosapis.

Tenpins.—White lauan, tanguile, and lumbayao are recommended, being not too heavy, fairly tough, and difficult to split. Palomaria has been used in Borneo with excellent results.

Vaulting poles.—Almaciga is recomended for trial as having a very fine, smooth, straight grain. Bamboo, however, is everywhere replacing wood for this use.

Stair work.

Balusters and handrails.—Acle, alintatau, amugis, aranga, banuyo, batete, batitinan, bitanhol, guijo, ipil, calamansanay, lumbayao, malugay, mangachapuy, molave, narra, pagatpat, tindalo, tucang-calao. A great deal of apitong is used for medium-grade work, and for the cheapest work all the lauans and much "miscellaneous lumber."

Risers and treads.—Molave and tindalo are the favorites for this purpose on account of their hardness and enduring color, the smooth, pale yellow of molave and the rich red of tindalo both becoming the more conspicuous the more they are scrubbed. Practically all the woods used for balustrades and many others are used also for treads and risers and, for medium-grade and cheap work, apitong and the lauans.

Paneling and other trim about stairs is naturally made, as a rule, of the same woods as the surrounding interior finish.

Staves. (*See* COOPERAGE.)

Tenpins. (*See* SPORTING GOODS.)

Ties and mine timbers.

The following are accepted as first-class railway ties by the Manila Railroad Company: Agaru, acle, acleng-parang, alupag, anubing, aranga, banaba, bansalagin, batitinan, betis, binukau, bolong-eta, bunog, camagon, dungon, dungon-late, ipil, kubi, malabayabas, malacadios, molave, narig, narra, palomaria, sasalit, sudiang, taba, tabau, tamayuan, tambulian, tiga, tindalo, tucang-calao and all other *Aglaias*, urung, the yacals.

The following are accepted as second-class ties: Agoho, amugis, antipolo, batino, binggas, bitanhol, guyungguyung, calamansanay, catmon, lamog, the macaasims, pagatpat.

A very large number of other species would make excellent ties if creosoted. As impregnation is effected with best results when large quantities of wood of one kind are treated and not mixed lots of various species, those woods obtainable in large, uniform lots would be the best for this purpose and practically the only woods that can be de-

Ties and mine timbers—Continued.

pended on for a large and continuous supply are the dipterocarps, of which the apitongs, the lauans, and palosapis are the most abundant. Next to these in quantity, and superior to the dipterocarps in hardness, are the woods of the mangrove family, the bacauans and pototans.

Tongues. (*See* VEHICLES.)

Tool handles. (*See* HANDLES.)

Tools, wooden. (*See* WOODEN TOOLS.)

Toothpicks. (*See* NOVELTIES.)

Treenails. (*See* SHIPBUILDING.)

Type. (*See* PRINTERS' MATERIAL.)

Vehicles.

The vehicle manufacturers of Manila (and the industry in Manila is typical of that of the whole Archipelago) fall rather sharply into four classes:

1. Large carriage shops, manufacturing carriages of various styles, as well as the best grades of the various two-wheeled vehicles known as the carromata, calesa, quilez, etc.; these shops have taken up also the repair and even entire construction of automobile bodies. There are about 15 such in Manila and probably a greater number scattered through the provinces. The latter are naturally not as well equipped as the best shops in Manila.

2. Smaller shops, manufacturing almost only carromatas and carretelas.[1] A few of these also make bull carts. Of this class and the next together there are over 25 in Manila.

3. Shops of size and capacity about the same as the above, but making almost exclusively bull carts.

4. Manufacturers of heavy horse-drawn carts and wagons. There is no organized native industry along this line. The small size of the native horses, the scarcity of good roads, and the universal use of the carabao and cart all contributed to prevent the use of large wagons. The American Army brought mules and draft horses, as well as heavy wagons of various styles. Later, both the Civil Government and some private firms imported American or Australian draft horses. Practically, the use of heavy horse-drawn vehicles is confined to governmental departments and their manufacture to two institutions, the land transportation shops of the Quartermaster's Department and Bilibid Prison, the latter being the Insular penitentiary located in Manila. The former makes all wagons used by the Army, and the latter the dump carts and heavy wagons used by the Government of the Philippines, by the city of Manila, and the various provincial governments.

The one wood used for practically all parts of all kinds of vehicles is guijo. Except for steel axles and iron hubs, many heavy wagons are built of guijo throughout. Shafts for light vehicles are bent by boiling them in a wooden tank heated by live steam and clamping them in forms until cool. They are reported to hold very well the curve so given them.

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[1] The carretela is a two wheeled cart with a light bed, a railing about 30 cm. high, two or three movable seats supported on the railing, and a flat top supported on four stanchions; it is at once the "poor man's carriage" and the universal delivery wagon for light loads.

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Vehicles—Continued.

The following are used for the different parts of various vehicles:

Hubs.—Palomaria and bitanhol (mostly for light vehicles); dungon, ipil, and yacal (carts and heavy vehicles); guijo (all classes).

Spokes and felloes.—Dungon, yacal, guijo, apitong; in the cheapest carromatas and carretelas unscrupulous workmen sometimes use red lauan.

Axles.—Dungon, guijo, ipil, yacal.

Shafts.—Lanutan is the favorite among the smaller shops for light vehicles. The carriage shops use hickory and ash (the latter from Europe). Cart shafts are almost always of guijo. The wagon shops at Bilibid Prison also use guijo for steamed bent shafts. Cheap carretelas sometimes have shafts made of a small but very thick-walled bamboo called bayóg.

Poles.—Dungon, ipil, guijo, bitanhol. Of these, guijo is used most.

Singletrees.—Guijo and, rarely, yacal; dungon is also used in provincial factories.

Beds.—Carts generally have a flat frame of guijo, the boards for filling in the bed being of apitong or lauan. Occasionally a frame is made of yacal; on the other hand, apitong and lauan are also used for the cheapest grade of frame. Wagon beds are generally made of guijo throughout.

Framework of automobile and carriage bodies.—Most commonly guijo; dungon, mangachapuy, and yacal are sometimes used on special orders.

Floors of carriages, carromatas, etc.—Guijo and, for cheaper work, lauan.

Panels.—Banuyo, guijo, tanguile, and various lauans.

Dashboards.—For high-grade work in natural finish, banuyo and narra; for cheaper grades, guijo, palosapis, mangachapuy, and various lauans.

Calantas is used for mud guards for carriages and automobiles.

Veneers.

There is no veneer industry as such in the Philippines. The Philippine Match Factory uses rotary veneer cutters for making both boxes and match sticks. This is the only veneer machinery in the Islands. Picture and mirror frame shops use white lauan and other cheap, soft woods sawn to about 3 millimeters thick for backing. Most of this material is sawn to order from logs or flitches in local mills, generally under supervision of the owner of the wood. Musical-instrument makers saw even thinner stuff by hand. Machine-sawn veneer would serve this purpose, but rotary cut veneer could not, of course, be used by them on account of the distortion and loosening of the fibers to which the process subjects the wood. No other material thin enough to be called veneer is used, except very rarely a bit of ornamental overlay on special jobs of cabinetwork.

For high-grade ornamental work in veneer the following are recommended: Agaru, acle, acleng-parang, bacauan-gubat, banaba, bangkal, banuyo, batete, batitinan, bitanhol, bolong-eta, camagon, dao, ebony, himbaba-o, calamansanay, calantas, kamatog, catmon, lago, lamog, lanete, lanutan, malacadios, malambingan, malasaging, and all other *Aglaias*, malatinta, manggis, maranggo, molave, narra, pagat-pat, palomaria, piagao, sibucao, supa, tabigi, talisay, tindalo, toog.

Veneers—Continued.

For the heavy veneers used for drawer bottoms, partitions, and interior paneling in desks and other furniture, and similar uses, the lauans and the natos would furnish excellent material. Being light, fairly tough, and difficult to split, the lauans would be equally good for light crates, fruit packages, wooden dishes, and similar articles made of cheap veneers.

Wharf building. (*See* BRIDGE AND WHARF BUILDING.)

Whipstocks. (*See* CANES.)

Windows. (*See* HOUSE CONSTRUCTION.)

Window sills. (*See* HOUSE CONSTRUCTION.)

Wooden tools. (*See also* HANDLES AND LEVERS.)

The number of woods used for wooden tools by carpenters and sawyers in Manila is very limited. The three chief classes of tools for which wood is used (exclusive of chisel handles) are planes, saw frames, and try-squares, straightedges, scratch gauges, etc. Planes are almost invariably of molave. This is hard, fine, and smooth, but chips easily at corners and edges and wears rapidly on the sole. Other woods used, but very rarely, are batitinan, camagon, calamansanay, mancono, and sampalok. The following would make good plane stocks: Agoho, aranga, banaui, bansalagin, sapwood of bolongeta and camagon, dungon, lamog, malasaging and other *Aglaias*, narig, sudiang, supa, tamayuan, tangal.

Handsaws were little known and less used before the American occupation and even now more than nine-tenths of all saws used by Filipino and Chinese carpenters are frame saws with blades ranging from 1/2 to 3 centimeters in width. For the frames mangachapuy, narra, and yacal are commonly used. For the long whipsaws used in sawing logs, guijo and yacal are much used; occasionally a frame is seen with the central strut of Oregon pine, but the Chinese sawyers sometimes use such very heavy woods as bansalagin and dungon.

For try-squares (both stock and blade), straightedges, gauges, etc., narra is the favorite; camagon, molave, and yacal are also used. Undoubtedly one of the best materials for this purpose is the sapwood of camagon and other species of *Diospyros*.

Mallets are comparatively little used. By far the best material, for weight, toughness, and difficulty of splitting, is dungon. Still heavier, but not as tough, are the camagons and mancono. Ship caulkers use a wood called mapilik, which they obtain from certain ship's officers sailing to the south, but the source has not been ascertained. It is very probably mapilíg, a very hard, heavy, rare, and little-known wood related to mancono, known only from Camarines and Albay, and there said to be used for hammers.

Part IV.—METHODS OF IDENTIFICATION.

In the species descriptions in Part V, there has been given for each wood not only its distribution and various local names, as well as the general appearance and mechanical properties, but also a short description of the minute structure, for the only positive means of identifying most woods is the structure as revealed in a clean, smooth cross section. It must not be supposed that such identification requires, in the great majority of cases, a laboratory full of scientific apparatus. On the contrary, the more conspicuous features in the structure of a given wood can, as a rule, be seen with no more elaborate apparatus than a good pocket knife, a fine whetstone, and a lens magnifying four or five diameters. No elements requiring the use of a microscope have been used in this work. Neither is it necessary to learn a vocabulary of new scientific terms, as almost all the various component elements (excepting those generally visible only under the microscope) can be grouped under a few comprehensive terms. These terms, which include all the elements whose relative abundance and arrangement need to be observed for our purposes, are as follows:

1. *Hard and soft tissue.*—The hard tissue constitutes, so to speak, the background of the picture in the cross section of most woods. It is generally more abundant than any other element and almost invariably appears darker, more compact, and smoother than the soft tissue. In the hardwoods, or broadleaved trees, the hard tissue is made up largely of the true wood fibers, which are long, thin cells, closed at both ends, whose main purpose is to provide mechanical support to the tree, the thickness of their walls as compared to the size of the internal cavity being the chief element determining the density and hardness of the wood. In the hardwoods, the vessels, or pores, attend to the business of conducting water and sap. In the softwoods, or conifers, there are neither wood cells nor pores, their place being taken (and functions performed) by the tracheids, a different kind of cells, which compose practically the whole bulk of the wood. For our purposes, however, no distinction need be made (nor, indeed, can any essential difference be observed with a hand lens) between tracheids and wood fibers. Moreover, but three softwoods are enumerated, namely, almaciga and the two pines.

The soft tissue is almost invariably lighter in color and of a more spongy appearance than the hard tissue. In practically all hardwoods, it forms narrow or broad rings, or else irregular patches, around the pores. Frequently these patches run together, forming more or less regular patterns of either continuous and parallel, or else broken, wavy, branching, or diagonal lines. In some woods the soft tissue takes the shape of regular patterns that are not related to the position of the pores. As a rule, very dense, hard woods contain little, and very soft woods, a great deal, of soft tissue. There are, however, many exceptions to this. Some woods contain conspicuous amounts of soft tissue, yet are very heavy, due to having very thick-walled wood fibers, while others, containing very little soft tissue, are light because their wood fibers are thin walled.

2. *Pith rays.*—These are groups of cells that run radially from pith

to bark at right angles to the grain. In the cross section they are visible to the naked eye in most woods and under the lens in all. They are composed of cells similar to those of the longitudinal masses of soft tissue and in the cross section are generally of nearly the same color as the latter. In longitudinal sections they are not generally conspicuous except when the section is nearly or quite radial. In such sections they form, in woods like oak and catmon, the "silver" or "flake" grain so familiar in quarter-sawn oak furniture. In tangential sections they form elongated dots or narrow lines which often appear darker than the neighboring wood fibers. Their relative thickness and width (or height, when considered in the natural position in the trunk of the tree) and their frequency are important aids to identification.

3. *Pores.*—Pores, or vessels, are tubelike elements lying between the wood fibers and quite distinct from them. Their length is undetermined; that is—being made up of a large number of cells placed end to end and communicating continuously—they are not limited, like the lumen or internal cavity of a wood fiber, to the length of a single cell. Strictly speaking, a vessel is one of these tubes, including in the term the opening and its wall, but for the purposes of our descriptions, the word pore will be used to mean only the lumen, or opening, while the annular wall is included in the term soft tissue, as with a hand lens no distinction is to be seen between the tissue of the vessel walls and the masses of soft tissue that either surround the vessels or form other patterns independent of them. The arrangement, shape, and size of the pores form the most conspicuous feature in the cross section of most woods. In some species they are arranged in more or less distinct concentric rows following the growth rings; such woods are called "ring porous." These are much rarer in the Tropics than in the Temperate Zone. In ring-porous woods, the largest pores are most numerous in the inner or early part of each ring, becoming either gradually or abruptly smaller and fewer toward the outer, or later, part of the ring. Woods in which the pores are more or less scattered are called "diffuse porous." Some have the pores arranged in longer or shorter, straight or oblique, radial rows, others in more or less wavy, often branching tangential lines (often with a tendency to form irregular, "herringbone" patterns) and a great many, finally, have them more or less evenly scattered without any regular arrangement. The largest pores are about like pinholes, while the smallest are barely, if at all, visible under a hand lens. In many woods, the pores are fairly uniform in size, in others very variable, while in some cases they are quite distinctly of two sizes. Sometimes all the pores are open, sometimes part or even all of them are filled with colored deposits, which latter are generally also plainly visible in longitudinal sections; in some woods, they are more or less completely filled with tyloses (see below), which sometimes appear as numerous thin cross partitions; such partitions, in the cross section, give the pores the appearance of being filled with soft tissue, while in longitudinal sections they give a dotted line effect.

4. *Tyloses.*—In many woods, as the sapwood cells die and are gradually converted into heartwood, there are deposited in them (most conspicuously in the pores) various colored substances which often completely fill the pores. Instances are: The sulphur-yellow deposits in ipil (*Intsia* spp.), white in dungon (*Tarrietia sylvatica*), and black in the ebony family (in which they not only fill the pores, but completely permeate all the elements of the wood). These are merely homogeneous masses of organic or mineral matter—that is, deposits in the strict sense of the word. Tyloses, on the

other hand, are growths—that is, they are cells which grow from the soft tissue surrounding the vessel into the internal cavity. When few and thin, they are frequently iridescent, glistening like tiny soap bubbles. When somewhat thicker, they frequently present the appearance of numerous cross partitions referred to above; this is characteristic, for instance, of many woods of the alupag family (*Sapindaceae*). When still more massive and crowded, they often give the pores the appearance of being completely choked with soft tissue (which, in fact, they are) and in such cases the contents of the pore, its wall, and the surrounding soft tissue often appear under the lens as one uniform light colored patch.

5. *Resin canals.*—These are found only in the pines and the lauan family (*Dipterocarpaceae*). In the pines they are found scattered singly or in very small groups. In the lauan family they are either scattered or arranged in conspicuous concentric lines which form the most striking characteristic of the family. Unlike growth rings these lines occur at very irregular intervals from the heart outward and, moreover, they are incomplete—that is, they very rarely form complete circles (See Pl. VI, fig. 48.)

6. *Growth rings.*—These are the concentric belts formed by the addition of material to the outside of the trunk during growth. Like ring porousness, they are rarer and, as a rule less distinct in Tropical than in Temperate Zone woods. The ring-porous character has already been described. In diffuse porous woods, however, the pores are often slightly more numerous in the inner part of the ring—that is, the line of distinction between the ring-porous and the diffuse-porous character cannot always be quite sharply drawn. Growth rings are marked by various other features. In some woods the outer portion is darker than the inner, in some denser, and often these two conditions go together, the darker look being really only a result of the denser texture. Often the dense tissue forms only a narrow belt at the end of the ring. On the other hand, the inner edge, or beginning of the ring, is often marked by a distinct, narrow line of loose-textured soft tissue. Sometimes the rings are very regular as to thickness and distinctness of color and texture, and from this condition there is found every gradation of irregularity and indistinctness down to total absence of rings.

7. *Ripple marks.*—Beside the above characteristics to be observed in the cross section, there is one feature in the longitudinal sections that is often of value for determining a species, namely, ripple marks. These are extremely fine, transverse, parallel, slightly wavy lines (about 5 to the millimeter in narra) resembling the marks made by ripples on a smooth beach. They are most common in tangential sections, but in some woods are found in all longitudinal sections. Generally they are plainly to be seen (often better on split than on planed surfaces) with the naked eye; in fact, they are frequently more distinct to the naked eye than under the lens. Ripple marks are found in very many woods, but in certain cases they serve to distinguish woods that might otherwise be confused, for instance, narra almost always has them and tindalo never.

The descriptions in Part V of the structure and other properties of the woods are invariably taken from the specimens in the working collections of the Bureau of Forestry. These are wood specimens collected by forest officers, together with botanical material taken in each case from the same tree as the wood and, therefore, absolutely authentic. When peculiarities of color or other properties occurring in commercial lumber, as distinct from these specimens, are described, this is generally specifically stated.

Part V.—SPECIES DESCRIPTIONS.

DURABILITY CLASSES.

The woods described below are divided into four durability clases. These indicate:

1. Very durable, for example, anubing, ipil, mancono, molave. Such woods are probably rarely attacked by insects, except after they have been softened by decay—that is, by attacks of fungi after long exposure to exceptionally severe conditions. They resist exposure to the weather or contact with the ground for long periods. All timbers in this class are believed to be at least equal to the most durable American woods and many of them surpass in durability any commercial timber of the temperate zone.
2. Durable, for example, calamansanay, palomaria, tindalo, tucang-calao. These woods are very rarely attacked by any insects and will last many years even in contact with the ground or exposed to the weather.
3. Fairly durable, for example, apitong, guijo, calumpit, catmon. Woods of this class are not commonly or severely attacked by insects. They resist the weather fairly well and last several years even in the ground. Most of the woods in this class would it is believed, compare with the woods of average durability in the North Temperate Zone.
4. Not durable. These woods although not termite proof are not specially subject to attacks of other insects—that is to say, they are not invariably attacked as are certain other woods; but the sapwood is often poor in this respect and woods of this class unprotected by paint or preservatives should not be exposed to conditions of constant moisture or of constant alternation between moisture and dryness. Thus, they are not recommended for use in the ground or for exposure to the weather, when woods of the other classes are available. There is included in this class no wood believed to be inferior to the medium-grade construction timbers of the United States and the classification has been made with special reference to Oregon pine and California redwood, which are the woods most commonly imported into the Philippines. The various lauans, which form the great bulk of the timber of this class, are mechanically stronger than redwood and Oregon pine. Redwood is by no means immune to the attacks of termites, while Oregon pine is known to be destroyed by them in a comparatively short time.

Certain woods which are known to be less resistant than the lauans to decay and insects, have their degree of durability designated, not by numbers, but by such phrases as "durability poor," "often attacked by beetles," etc.

LIST OF ABBREVIATIONS.

The following abbreviations are used of names of islands or island groups, provinces, subprovinces, and languages:

Agus.	Agusan Province.	Ant.	Antique Province.
Ala.	Alabat Island.	Bab.	Babuyan group.
Alb.	Albay Province.	Bal.	Balabac Island.
Amb.	Amburayan Subprovince.	Bas.	Basilan Island.

Bat.	Bataan Province.	Mal.	Malamaui Island.
Batg.	Batangas Province.	Man.	Manila.
Bats.	Batanes Group.	Mar.	Marinduque Island.
Beng.	Benguet Subprovince.	Mas.	Masbate Island.
Bil.	Biliran Island.	Min.	Mindoro Island.
Bkl.	Bikol language.	Mis.	Misamis Province.
Bis.	Bisaya language.	Mtn.	Mountain Province.
Boh.	Bohol Island.	N. E.	Nueva Ecija Province.
Bon.	Bontok Subprovince.	N. V.	Nueva Vizcaya Province.
Buk.	Bukidnon Subprovince.	Neg.	Negros Island.
Bul.	Bulacan Province.	Occ. Neg.	Occidental Negros Province.
Bur.	Burias Island.		
Bus.	Busuanga Island.	Olu.	Olutanga Island.
C.	Central.	Or. Neg.	Oriental Negros Province.
Cag.	Cagayan Province.	Pal.	Palawan Island.
Cam.	Camarines Province.	Pamp.	Pampanga Province.
Cap.	Capiz Province.	Pang.	Pangasinan Province.
Cat.	Catanduanes Island.	Riz.	Rizal Province.
Cota.	Cotabato Province.	Rom.	Romblon Island.
Cul.	Culion Island.	Sam.	Samar Island.
Dav.	Davao Province.	Sib.	Sibuyan Island.
Din.	Dinagat Island.	Siq.	Siquijor Island.
Guim.	Guimaras Island.	Sor.	Sorsogon Province.
I. N.	Ilocos Norte Province.	Sur.	Surigao Province.
I. S.	Ilocos Sur Province.	Tab.	Tablas Island.
Ilk.	Iloko Language.	Tag.	Tagalog language.
Ilo.	Iloilo Province.	Tar.	Tarlac Province.
Lag.	Laguna Province.	Taw.	Tawitawi group.
Lan.	Lanao Province.	Tay.	Tayabas Province.
Ley.	Leyte Island.	Tic.	Ticao Island.
Lep.	Lepanto Subprovince.	Un.	Union Province.
Lub.	Lubang Island.	Zam.	Zambales Province.
Luz.	Luzon Island.	Zambo.	Zamboanga Province.

The term "miscellaneous lumber" so often used in the following descriptions, though self-explanatory, perhaps needs a few words of comment. The smaller operators, broadly speaking, select for felling those trees that they know to be more or less fitted for their purposes, or that they can sell to the mills (whether steam or hand power) under the local names, or with no name at all; the local name used in a given case may or may not be the official and current commercial name of the species, but as long as the consumer takes the wood, this makes no difference. The larger operators, especially those who have their mills on the cutting area, as almost all the larger operators have them now, cut everything regardless of name or lack of name. Their operatives are, in large part, not woodsmen native to the locality, so that they are not familiar with names of those species which, for their small size, rarity, inferior quality, or other reasons, are not well known. The result is that only those woods which are well known on account of their abundance or superior qualities are sorted out in the mill and the yard, the rest going into the "miscellaneous piles." In some yards this is roughly divided into hard and soft.[1]

[1] It must always be kept in mind that in the Philippine lumber trade these terms must be taken literally and have nothing to do with the American use of "softwoods" for conifers and "hardwoods" for broadleaved trees.

In the Manila yards, the "soft miscellaneous," if fairly sound and clear, sells at an average of about ₱40 per M., and "hard miscellaneous" at ₱50 to ₱60 or upward.

As regards the prices cited, the comments on this subject in Part I, p. 14, should be kept in mind.

DESCRIPTIONS.

PINACEAE.

[Pine family.]

This family is represented in the Philippines by only three species, none of which are of any great importance in the lumber trade. Almaciga, though found in almost every island, occurs as a rule in the higher mountains and so has never been cut to any extent, while the two pines are found only in very limited regions.

Genus AGATHIS.

A. alba Foxw. (Plate I, fig. 1.) ALMÁCIGA.[1]

One of the largest trees of the Philippines, reaching 200 centimeters or more in diameter; reported from: Cag., Isa., Abra, Beng., Lep., N. E., Bul., Zam., Bat., Riz., Tay., Cam., Alb., Sor., Min., Neg., Mis., Mindanao (almost all provinces), Pal.

Local names.—Adiáñgau, dadiáñgau or ladiáñgau (Tay., Cam., Alb., Sor.); aningá (Beng.); anténg (N. E.); badiáñgau (Neg.); baltík (Pal.); bunsóg (Beng.); makau (Mis.); olensago (Beng.); sálang, sáleng (Cag.); sálong (Tay., Cam., Alb., Sor.); títau (Abra); úli (Zam.).

Wood moderately hard, flexible, and tough, though not resilient; moderately heavy; sapwood small, scarcely distinct from heartwood; heartwood pale yellow, sometimes with faint pinkish or brownish tinge, generally turning to an even, very pale brown in drying; grain very straight; texture very fine and smooth; seasons well; very easy to work. Durability under severe conditions not well known, but excellent in dry situations; rarely or never attacked by beetles, but not termite proof.

Structure.—Pith rays numerous, fine to moderately thick, indistinct; individual cells (tracheids, see p. 84) with a good hand lens plainly visible in a very smooth cross section, arranged in perfectly regular radial rows; growth rings marked by a fine, indistinct, light-colored line.

Uses.—Has only recently come into the market in small quantities with miscellaneous lumber; little or nothing known of local uses; would be a very pretty wood for carving and pyrography panels and is recommended for trial in sounding boards of musical instruments; as sold with miscellaneous lumber, is put to all the most ordinary uses; has been used with good results for lumber scale sticks; would be a good wood for similar articles, such as meter sticks, draftman's triangles, curves, etc.

Supply.—Very limited at present; but, as larger operators work further into the mountains, will undoubtedly increase somewhat.

Prices.—Sold so far only with cheap or medium grade miscellaneous lumber at about ₱40 per M.

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[1] The Spanish equivalent of "mastic;" the resin of the tree, which is practically identical with the Kauri gum of Australia and has always been collected both for local use and for export in considerable quantities, is much better known than the wood, being exported as "manila copal" to Europe and America, where it is used for the manufacture of high-grade varnishes. The native names sálang, sáleng, sálong also mean "resin," but the Spanish name is almost everywhere known.

Genus PINUS.

Two species, one found in the Mountain Province, the other in the interior of Mindoro, while small quantities of both are found near the coast of Zambales.

P. insularis Endl. (Plate I, fig. 2.) SÁLENG or BENGUÉT PINE.

A moderately tall, straight tree, up to 140 centimeters in diameter; reported from: I. S., Abra, Bont., Beng., N. E., Pang., Zam.

Local names.—Bel-bél, boo-bóo, bul-búl, ol-ól (Beng.); pariná' (I. S.); sáhing (N. E.); sáleng (I. S., Bont., Beng.); sálit (Zam.).

Wood soft to moderately hard; moderately heavy to very heavy, resinous heartwood very much heavier than sapwood, thoroughly air-dry specimens of former sometimes heavier than water; sapwood merging gradually into heartwood, except in large old trees, where the very resinous heartwood and the less resinous sapwood are quite sharply distinguished; color ranging from pale yellow to rich orange brown; old heartwood almost completely impregnated with resin; grain straight or slightly crossed; texture fine and smooth; seasons well; easy to work, except for gumming tools. Durability of sapwood not very good; resinous heartwood, excellent; rarely if ever attacked by insects, even termites avoiding the heart and resinous knots.

Structure.—Pith rays numerous, fine to very fine; individual cells finer than in almaciga, regular radial arrangement barely visible under hand lens; single resin canals widely scattered; growth rings very distinct, the softer, lighter-colored inner part of the rings occupying much less than half, and the dense, resinous outer part of the rings much over half, of the total area.

Uses.—In those parts of the Mountain Province where pine is very abundant, the supply of other woods is practically nil and pine is put to all uses where wood can or must be used; where pine occurs mixed with other woods, it is very little used. It is never brought to the Manila market.

Supply.—Abundant through a long narrow belt in northwestern Luzon; comparatively scarce on Zambales coast.

Prices.—About ₱70 per M. in Baguio.

P. merkusii Jungh. & de Vr. TAPÚLAU or MINDORO PINE.

A tree up to 90 centimeters in diameter; reported only from Zambales and Mindoro, with local names TAPÚLAU (Zam.) and agóo or agúu (Min.).

Wood in all respects like above, but apparently even more resinous.

GRAMINEAE.

[Grass or bamboo family.[1]]

The only members of this family that furnish material of large size in great quantities for construction (with the exception of various grasses used for thatching), or for the manufacture of furniture and implements, are the bamboos. The erect bamboos are the most abundant and useful, but some of the climbing bamboos are also used to a lesser extent.

All bamboos have cylindrical, hollow, jointed, stems, with walls ranging from less than one-half centimeter to 4 or 5 centimeters in thickness. In

[1] For the notes on this family and the following the writer is largely indebted to an unpublished MS. loaned him by Mr. E. D. Merrill, Botanist, Bureau of Science. Bulletin No. 49 of the Bureau of Education, "Industrial Fiber Plants of the Philippines," by Theodore Muller, Manila, 1913, was also consulted for uses, local names, and distribution.

all species, the walls are thickest at the butt and become gradually thinner toward the tip. In some species, the wall of the first few joints above the rootstock is so thick that the stems are almost or quite solid, the central hollow being reduced to a small hole of the diameter of a pencil, or less. The erect bamboos have, as a rule, perfectly straight stems, while the climbing bamboos grow almost always in a zigzag fashion, the stem changing its direction sharply at every joint.

The following lists, though far from complete, give an idea of the immense variety of uses to which bamboos are put:

House construction.—Posts, girders, joists, studding, laths, rafters, purlins, door and window frames, doors and shutters, flooring, roofing (split and laid like tile; rare), sauali[1] (siding, ceiling, doors, shutters, and even floors), eave troughs, and down spouts (occasional).

Furniture and household implements.—Beside benches, chairs, tables, beds, bookshelves, and similar larger furniture, bamboo is used for minor articles too numerous to mention.

General structural work.—Scaffolding and staging of all kinds, temporary bridges and docks, centering for masonry culverts and arches, temporary derricks and "jim poles," temporary pipe lines for water, fences, fish weirs, shade frames for nursery beds, trellises, bean poles; also a favorite for town and barrio school flagpoles.

Navigation.—Masts and spars for boats, praus, lighters, and sampans, oar shafts, boat poles, seats and false bottoms, bailing dippers, rafts, floats for heavy timber, movable roofs of lighters, stanchions, and ribs for boat awnings.

Land transportation.—Sledges, yokes, vehicle shafts, cart and carretela bottoms, ribs of vehicle tops; the very thick-walled and strong lower parts of the heavier species are used as rollers in transporting heavy objects; next to palma brava (see palm family), bamboo is also the most widely used material for carrying poles.

Beside the uses above enumerated, bamboos are also used, split into splints ranging from the fineness of a panama hat fiber to broad pieces of the full natural thickness of the wall, for a great variety of textile purposes in the manufacture of hats, mats, baskets, screens, fruit crates, poultry cages and crates, plaited barrel hoops, plaited or twisted cables, etc.

The bamboos of the Philippines belong to about 40 known species, representing 8 genera; the following are the best known and most important species.

Genus BAMBUSA.

A genus of about five species in the Philippines, of which the first species described below is the most important bamboo in this country.

B. blumeana Schultes f. SPINY BAMBOO.

A tall, straight bamboo, stems ordinarily from 10 to 12 centimeters in diameter, and about 20 meters high, the lower part of the stems surrounded by a dense thicket of spiny branches. Found in all settled areas at low and medium altitudes, apparently always planted, and undoubtedly introduced from the Malay Archipelago in prehistoric times.

Local names.—Aonóo (Bis.); batákan (Sur.); baúgin (Pamp.); bayóg

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[1] Sauali is a matting made, generally in a diagonal basket weave, of split, flattened, bamboo splints. Where made locally, it is often woven in pieces of approximately the shape and size required for the purpose in view; as a commercial article it is woven in sheets about 2.5 meters wide and 10 to 15 meters long.

or bayúg (N. V., Zam.); caña-espina (Span.); dugían, kabugáuan (Bkl.); kawáyan (Tag., Bkl., Bis., Ilk., Pamp.); kawáyan-géd (Bis.); kawáyan ñga bulílau (Occ. Neg.); kawáyan-siítan (I. S., Un.); kawáyan-tiník or k.-matiník (Tag., *spiny bamboo*); kawáyan-totóo (Tag., Bkl.); marurúgi, rugían (Bkl.); pasíñgan (Cag.).

Uses.—The best structural bamboo in the Philippines; house construction, temporary bridges and wharfs, fish weirs, heavy sauali, all purposes where the strongest and most durable bamboo is required; also furnishes some of the best material for various finer hat, mat, and basket work.

Supply.—Probably in few regions equal to the demand; complaints are frequent in Manila that the supply brought to the market is of full-grown, but not yet thoroughly mature, stems. This is probably not so commonly the case in smaller markets.

Prices.—One of the highest-priced bamboos in the Islands, due partly to its superior qualities and partly to its being more difficult to harvest and to transport. At points in provinces where there is a steady supply, sells as low as ₱10 per 100. In Manila, prices range from about ₱12 to ₱15 for the most ordinary grades to ₱50 for selected lots of the longest and straightest stems; for large lots of average size and quality, about ₱30.

B. vulgaris Schrad. KAWÁYAN-KILÍNG.

A tall, straight bamboo reaching about the same dimensions as the preceding. It has not the spiny branches of *B. blumeana*, the stems are smoother, with less projecting nodes and slightly thinner walls.

Local names.—Bulínau (Ilk.); burírau (Ant.); botóng or butúng (Cam., Alb., Cap.); kabolóan (Alb.); kawáyan-bayúgin (N. E.); kawáyan hobéro (Lag.); KAWÁYAN-KILÍNG (N. V., N. E., Tar., Un., Zam., Bul., Riz., Man.); kawáyan ñga dalusa (Occ. Neg.); kawáyan sa China (Cebu); lunas (Ley., Boh.); sinabáng (Cebu); taiwanák (Cav.); tewanák (Lag.).

Uses.—Wherever abundant, put to practically all uses known for bamboo. Spiny bamboo is preferred for heavy work on account of its greater strength and durability, but for furniture, floors, door and window frames, water containers, and similar uses kawayan-kiling is very generally preferred because of its smoother exterior.

Supply and prices.—In the Manila market the supply is much less abundant and regular than that of spiny bamboo and prices probably on the average somewhat lower. In one region, at least, the Province of Camarines, prices are regularly somewhat lower, probably due not so much to lesser demand as to the greater ease of extraction and transportation.

Genus DENDROCALAMUS.

A genus of three or four species, of which botong is the best known.

D. latiflorus Munro BOTÓNG.

A tall, very smooth and rather thin walled bamboo reaching nearly or quite the same dimensions as the *Bambusas*.

Local names.—Bólong-sína (Cam.); BOTÓNG (Cam., Alb., Cebu); butún (Cebu); kabolóan (Alb., Sor.); kawáyan-sína (Tag.); patón (Sor., Sur.).

Uses.—Much the same as kawayan-kiling.

Supply and prices.—Less widely distributed and less abundant than kawayan-kiling; little or not at all known in Manila market; no prices recorded, but the writer remembers one sale of several hundreds in Camarines at ₱10 per 100.

Genus DINOCHLOA.

A genus of four or five species, all thick walled, scandent forms, of which zigzag bamboo is the most widely distributed and best known.

D. scandens (Bl.) O. Ktze. ZIGZAG BAMBOO.

A climbing plant, with stems 2 to 3 centimeters in diameter, more or less sharply bent at each node, the internodes 20 to 45 centimeters long.

Local names.—Bia (Pal.); balukáui (Min., Cebu); bukáu (Bas.); bukáui (Bal.); timák, usíu (Min.).

Uses.—No special uses are recorded, but said to be more or less utilized for general purposes. Probably adapted to all same uses as the Bikals (climbing species of *Schizostachyum*).

Genus GIGANTHOCHLOA.

Only one species known in the Philippines.

G. levis (Blco.) Merr. BOLÓ.

A tall, smooth, straight bamboo very similar to botong (*Bambusa vulgaris*) and often known by the same names.

Local names.—Bokó, BOLÓ (Cap.); botóng (Cap., Boh.); kawáyan-sína (Bul.).

Supply and prices.—Not abundant, little if at all known in Manila market, and no prices recorded.

Genus SCHIZOSTACHYUM.

The most numerous in species of the genera of bamboos in the Philippines, containing several widely distributed and well-known species, of which the following are the best known.

S. dielsianum Merr. BÍKAL-BÁBUI.

A climbing bamboo, with very thick walled, zigzag stems, similar to *Dinochloa scandens.*

Local names.—Bíkal (Cag., Un.); the name is also common in the Bikol provinces and many other regions, but whether applied to this or to other species is not in all cases recorded); bikal-bábi (Pamp.); BÍKAL-BÁBUI (Zam.); bíkal-machín (Pamp.); loob (Boh.); usíu (Cav., Lag.); the local names of this and the following seem to be applied to both almost indifferently.

Uses.—Beside being used locally for general purposes, the stems are reported as being used for chairmaking in Cagayan and Cavite.

Supply and prices.—Very abundant in many regions, but nowhere a regular article of commerce.

S. diffusum Merr. (*S. acutiflorum* Munro). BÍKAL.

Practically identical with the preceding.

Local names.—Baliaro, balikau (Ilo.); BÍKAL (I. S., Abra, Pang., Pamp.; see remark after "bikal" under preceding species); bongbóng (Cebu, Boh.); gimák (Bat.); hindi, indi, inri (Alb., Sor.); lilít (Pamp.); and names of preceding.

Uses, supply, and prices.—As for preceding; also reported by Bureau of Education as a favorite for basket work.

S. lumampao (Blco.) Merr. (*S. mucronatum* Hack.) BÚHO.

An erect, thin-walled bamboo reaching a maximum diameter of 8 to 10

centimeters and a height of 10 to 12 meters. Gregarious and often covering large areas to the almost entire exclusion of trees and shrubs.

Local names.—Bagákai (Alb., Sor., Ley., Cap., Ilo., Boh.); BÚHO (Tag.); caña-bojo or caña-boho (Span.-Fil., derived from preceding); bokáue, lumampáu (Tag.); kawáyan-sungsúng (Lag.); orás (Alb.).

Uses.—Put to all uses of other bamboos except where considerable strength and durability is required. Used in greater quantities than any other species in the manufacture of *sauali.* (See footnote, p. 91.) It makes an excellent paper pulp and on account of its great abundance, high yield of cellulose and ease of manufacture, is one of the most promising materials in the Islands for this purpose.

Supply and prices.—Buho is brought into the Manila market as a regular article of traffic, but also in the form of floaters for rafts of heavy timber. The quantities brought in are much less than of the structural bamboos. According to size and quality they sell at prices ranging from ₱2 to ₱5 per 100.

PALMAE.[1]

[Palm family.]

A large and important family which, although not supplying timber in the usual sense of that word, supplies material for a very great variety of structural and other industrial uses.

The inner part of practically all palms is a soft, pithy mass, not durable as regards resistance either to decay or to insects, but many species among the erect palms possess a hard outer shell ranging in different kinds from less than 1 centimeter to 4 or 5 centimeters in thickness. This shell is generally very hard, heavy, very strong and stiff, very resilient, and resists decay and insect attacks as well as some of the best woods. It is the wood of this outer shell that is commonly known as palma brava (Spanish for "wild palm," as distinguished from the cultivated coconut and betelnut palms). The name palma brava has no specific significance, being applied in different regions to any species that furnishes a wood large enough and strong enough for structural purposes, bows, carrying poles, etc. The climbing palms, or rattans, possess only a very thin, tough, and flexible outer shell. It is this shell which, split into strips of even width, forms the almost universal tying and lashing material in the Philippines and also the familiar "cane" used for seats and backs of chairs. When split by hand, the core is wasted, but prepared by machinery, the round, rather rough core constitutes the "reed" used in making so-called reed furniture.

The following lists, though far from exhaustive, indicate some of the chief uses to which the palms are put.

Whole stems of erect palms.—House posts, rural telephone and telegraph poles, piles, porch and interior columns, cylinders for blacksmith's bellows; some of the very small species are occasionally used for canes, clubs, spear shafts, etc.

Split stems of erect palms.—Joists, rafters, flooring, vehicle shafts (rare), carrying poles, spear shafts, bows, spear and arrow heads, parts of fish and game traps, rake and harrow teeth, parts of other agricultural and of household implements, canes and clubs, fishing-rods, scabbards, all kinds of tree nails, pegs and dowels, handles for axes, hammers, chisels, etc.; occasionally used for parts of small pieces of furniture and cabinet work and for inlaying.

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[1] See footnote on *Gramineae*, p. 90.

Whole rattans.—Framing of chairs, settees, light tables, hatracks, etc.[1] logging, rafting, ferry and suspension bridge cables; standing rigging of boats and praus; frames for heavy baskets, crates, pack saddles, pack baskets; spear shafts, canes, whipstocks; a peculiar and in some regions very common use of some of the smallest kinds is for clotheslines.

Split rattans.—Ties and lashings in construction of houses, bridges, landings, fish weirs, fences, scaffoldings, ladders, bamboo centering for culverts and arches, sledges and other vehicles, agricultural and household implements, furniture, boats, rafts, etc.; bale ties for abacá, tobacco, sugar etc.; plaited hoops for cooperage; wicker covering of demijohns; caning and winding of rattan, bamboo, and wooden furniture.

In addition to these uses of the trunks or stems, the leaves and petioles are utilized for numerous industrial purposes, such as the manufacture of mats, bags, hats, baskets, and other textile uses, as well as for thatching, for which last use various palms furnish the almost universal material throughout the Archipelago.

The following are among the most important genera and species of palms and rattans:

Genus ARECA.

A genus of three or four native species and the betelnut palm, the latter introduced in prehistoric times and very widely cultivated for its nut.

A. catechu L. BÚNGA or BETELNUT PALM.

An erect palm with a smooth straight trunk, about 15 to 20 centimeters in diameter. Used occasionally for temporary construction; if exposed to weather or in contact with ground, is destroyed by decay and insects inside a year, but as flooring in bamboo houses lasts several years.

Genus ARENGA.

A genus of three or four species, of which only one is of any importance.

A. saccharifera Labill. KÁONG or SUGAR PALM.

A tall palm reaching a diameter of 40 centimeters or more. In some regions small quantities of a starch are obtained from the pith. More commonly, the trees are tapped for palm cider, from which sometimes sugar is made, and sometimes alcoholic drinks and vinegar. The leaves are said to make very durable thatching material. The wood is very rarely used, being of poor quality as regards strength and durability.

Genus CALAMUS.

This is the largest genus of the family in the Philippines, containing nearly 40 known species. They are all climbers, their stems being the rattans of commerce. These range from less than half a centimeter to about 5 centimeters in diameter and occasionally reach a length of 200 meters.

Very little is known of what species produce either the best qualities or the greatest quantities of rattan. The numerous local names seem to be very loosely applied to many different species and, except in a few

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[1] This industry has become of considerable importance in the last few years, especially in Bulacan Province; the furniture is modeled chiefly after the familiar Vienna bentwood ware and in one respect is decidedly superior to the latter; the Vienna furniture is very frequently attacked and destroyed by boring beetles, while rattan seems to be rarely or never touched by them. A very large proportion of moving picture theaters, restaurants and other public places in Manila are now furnished almost entirely with these chairs.

cases, it is impossible to compare those used for a given species in one region with those used in any other region. The most widely known names appear to be such as have only a generic meaning, equivalent to the Spanish *bejuco* and English rattan.

Genus COCOS.

Beside a recently introduced ornamental palm (*Cocos plumosa* Hook.), there is found in the Philippines only one species, the coconut.

C. nucifera L. COCONUT PALM.

Cultivated in almost every island and province. According to an estimate by a member of the Bureau of Agriculture, there are 45,000,000 trees in the Archipelago.

The trunk has a hard outer shell from 2.5 to 5 centimeters thick. The wood is lighter in weight and color and not quite so hard and durable as that the *Livistonas*. It is not infrequently used locally for temporary bridges, for piling along waterfronts and wharfs, etc. It seems to be not quickly destroyed by teredo and, in the water or in very wet situations, lasts much better than where exposed to alternate drouth and humidity. Also used occasionally for flooring and parts of household and agricultural implements.

Genus DAEMONOROPS.

A genus of seven known species, all climbing palms like *Calamus*. The stems are put to practically the same uses as the rattans of the latter genus, but, though little is known of the qualities of the individual species, it is believed that the rattans furnished by *Daemonorops* are all inferior at least to the better kinds furnished by *Calamus*. It is not known whether any quantity of *Daemonorops* is found among export rattans.

Genus KORTHALSIA.

A genus of two or three known species of rattans. No special uses are known for any of them, but they are undoubtedly used locally for the same purposes as the other rattans and it is possible that they furnish some part of the commercial export material.

Genus LIVISTONA.

A genus of seven known species, tall palms with trunks of the shape and size of the coconut palm, but with fanshaped leaves. The species of this genus are among the most widely distributed in the Islands and furnish a very large part of the "palma brava" wood. The best known species of the genus is

L. rotundifolia Mart. ANÁHAU.

Local names.—ANÁHAU (Tag., Bkl., Bis.); abíang (Pamp.); labíd, labíg, anáau (Ilk., Pamp.); anáu, labík, balláng, saráu, taráu (Cag.); bagsáng (Bis.); báhi' (Bkl., Bis.); balak (Moro); bulnó (Bkl.); luyong (Zam., Bat.); palma brava (Span.-Fil).; pílig (Pol.); tíkal (Tag.); tíkis (Zam.).

Wood hard, heavy, tough, flexible and very resilient; dark brown, turning nearly black with age and exposure; rather easily split into long narrow strips in a radial direction, but will not split straight tangentially; fairly easy to work and takes a beautiful polish.

Uses.—Piling (said to last several years, even where exposed to teredo); posts; beams, joists, rafters; flooring; sometimes used (split into strips as for flooring) for sheathing under galvanized iron roofs as a protection against heat; the favorite material in the hills for bows and spear

shafts and in towns for carrying poles; on account of its resiliency, makes a superior material for fishing rods.

Supply and prices.—Widely distributed, but nowhere abundant and, with one exception, hardly ever a regular article of trade; this exception is formed by the pinggas (carrying poles), oval strips about 3 to 4 centimeters thick, 6 to 8 centimeters wide, and about two meters long, which are brought to Manila from Bulacan, Rizal, Laguna and other neighboring provinces and are sold at from ₱3 to ₱5 each.

L. sp. TARÁU.

This is the only large palm found truly gregarious in the Philippines; groves of hundreds or thousands of trees occur in the Cagayan Valley. The wood is identical with that of anahau and has been used rather extensively for wharfs in the ports at the mouth of the Cagayan River, as well as for the other uses above enumerated. The polished palm-wood columns used in all the Philippine exhibits at the Panama-Pacific International Exposition were of this species.

Beside the above, the stems of the lumbiá or sago palm (*Metroxylon rumphii* Mart.) and of aníbong (*Oncosperma filamentosum* Bl.), both rather common in parts of the Bisaya Islands and Mindanao, are locally used for spear shafts, bows and flooring.

CASUARINACEAE.

[Agoho family.]

A family containing but one genus, of which the best known species, agoho, the cassowary tree of India and she-oak of Australia, is common on sandy shores of the Australian and eastern Indo-Malayan regions and conspicuous on account of its resemblance to the conifers.

Genus CASUARINA.

C. equisetifolia Forst. (Plate I, fig. 3.) AGÓHO.

A medium-sized tree, up to 90 centimeters in diameter, with a straight, tapering bole, generally deeply fluted at the base; found in practically every coast province and on sandy flood plains of large rivers.

Local names.—Agó (Cag.); AGÓHO or agóo (Bab., Abra, I. S., Tar., Zam., Pang., Cam., Alb., Sor., Min., Mas., Tic., Rom., Dav., Pal.); agóso (Zam., Bat., Pamp., N. E.); aróho or aróo (I. N., I. S., Abra, Cag.); karamútan (Moro); malabóhok, marabóhok (Bis.).

Wood very hard; heavy to very heavy, specific gravity 0.704 to 0.942 (Foxworthy); sapwood pale brown, sometimes merging gradually into heartwood, sometimes very sharply distinguished from it; heartwood light to dark reddish brown, with irregular belts of light and dark color; grain straight as a whole, but often with a very regular short wave; texture fairly fine; very difficult to work and surface. Durability at least II; even sapwood rarely attacked by insects.

Structure.—Pith rays very fine and very broad, the broad ones widely scattered; pores medium sized, in irregular radial or diagonal strings, often filled with yellowish deposits; soft tissue forming thin rings about pores and very numerous, fine, wavy, often branching concentric lines similar to those in oak; no growth rings.

Uses.—Piling; ties; poles; paving blocks; house posts, bridge and wharf construction; beams, joists, rafters; window sills; handles; firewood; charcoal.

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Supply.—Widely distributed on sandy seacoasts and river valleys, but not abundant.

Prices.—About ₱100 per M., but not now found in Manila market.

Casuariana rumphiana Miq., MOUNTAIN AGÓHO, *C. sumatrana* Miq., the latter found only in Palawan, Agusan and Zamboanga, and several other species are found on lowlands, except sandy beaches, and frequently in the mountains; they rarely come into the market with miscellaneous lumber. They can be distinguished from agóho by their very numerous broad pith rays, rather regularly spaced among still more numerous very fine ones; otherwise, they seem to have the same structure and general properties as agóho.

FAGACEAE.

[Katabang or oak family.]

Genus QUERCUS.

Between 35 and 40 oaks occur in the Archipelago, generally in the more mountainous regions, though in some places they occur only one or two hundred feet above sea level. Most of them appear to be of very limited distribution, only about half a dozen having been reported from more than three or four localities each. Many are small trees or even shrubs, but the largest species are tall trees reaching diameters of from 40 to 100 centimeters.

The following names are on record for the genus, regardless of species: babaisákan (Tay.); baiúkan (Riz.); bakálau (Zam.); banggái (Ley.); barusang (Bul.); basákan (Tay., Cam.); bultók (Abra); dalútan (I. S.); diráan (Pan.); íhip (Zam.); iklík (Beng.); KATÁBANG (Zam., Bat., Lag.); KATILÚK (Beng.); KILÓG (Beng.); láian (Agus.); makuláb (Cag.); MANÁRING (Isa., N. V.); MANGGASIRÍKI (Bul.); manloáb (Riz.); natilég (Beng.); paláien (Abra, Bont., Beng.); palonápoi (Zam.); pañganán or PANGNÁN (Bat.); puso-púso (Bat., Mar.); oláian or ULÁIAN (Cag., Lag., Batg., Mis., Dav., Lan.); sitaldag (Beng.); takalpí (Min.); tiakdóg (Beng.); tikalód (Alb.); tiklík (Beng.).

Though varying somewhat in color and texture, the woods of the oaks are practically all of one type; wood moderately hard to hard; heavy to very heavy, specific gravity 0.921 (Puigdulles); sapwood 2 to 5 centimeters thick, pale yellowish brown, not quite sharply marked off from heartwood; heartwood light to dark brown; grain straight, pith rays forming long, straight brown lines on slash-sawn, and an extremely broad, showy silver grain on quarter-sawn face; texture fine, dense, smooth in most specimens, somewhat porous in others; seasons well if carefully stacked, otherwise liable to split and warp considerably. Durability probably III; not attacked by beetles.

Structure.—Pith rays distinctly of two kinds, numerous very fine ones (from 8 or 10 to 40 or 50) between every two large ones; pores small to medium, open (i. e., with few or no tyloses), forming irregular, wavy, broken and branching radial lines between pith rays; soft tissue forming numerous (3 to 10 to the millimeter of radius) wavy, fine but distinct, concentric lines, and indistinct, irregular patches about groups of pores; growth rings sometimes marked by a narrow, indistinct belt of darker tissue. (Plate I, fig. 4.)

Uses.—Posts; beams, joists, rafters; tool handles; flooring; if found to absorb preservatives well, would make superior railroad ties and paving

blocks. Puigdulles says: "* * * is as excellent for construction as its congeners of the Spanish Peninsula, but little used on account of the difficulty of extraction."

Supply and Prices.—Rarely marketed, except in small quantities mixed with miscellaneous lumber, though small lots of good boards may bring as high as ₱120 to ₱150 per M.

The following are the largest and best known species of *Quercus:*

Q. bennettii Miq. PANGNÁN.

A tree up to 70 centimeters in diameter; reported from: I. N., N. E., Pang., Pamp., Zam., Bat., Lag., Batg., Tay., Sam., Dav.

Q. caudatifolia Merr. KATÁBANG.

A tree up to 50 centimeters in diameter; reported from: Cag., I. S., Beng., Pang., Bat., Riz., Cam., Neg., Dav.

Q. jordanae Lag. KATILÚK.

A tree up to 65 centimeters in diameter; reported from: Beng., Abra, Lep., Pal.

Q. llanosii A. DC. ULÁIAN.

A tree up to 50 centimeters in diameter; reported from: Cag., N. E., Zam., Bat., Riz.

Q. luzoniensis Merr. KILÓG.

A tree up to 60 centimeter in diameter; reported from: Cag., Abra, Lep., Beng., Zam.

Q. ovalis Blco. MANGGASIRÍKI.

A tree up to 70 centimeters in diameter; reported from: I. S., N. V., Bul., Pamp., Zam., Bat., Riz., Tay., Cam.

Q. soleriana Vid. (Plate I, fig. 4.) MANÁRING.

A tree up to 100 centimeters in diameter; reported from: Cag., Isa., Beng., Bul., Zam., Bat., Lag., Tay., Cam., Alb., Min., Cap., Sur., Agus., Mis.

ULMACEAE.

[Malaikmo family.]

A family represented in the Philippines by only one genus of timber trees, *Celtis*, to which belongs also the American hackberry.

Genus CELTIS.

A genus of four or five species, of which only two are widely distributed and well known, the others being smaller and much rarer trees; the same local names are applied almost indifferently to all species and their woods are practically identical.

Local names.—Abúyo or habúyo (Zambo.); diladiláan (Riz.); diladíla-asu (Pamp.); lúnas-batú (Riz.); kayongkóng (Cebu); MAGABÚYO or maghabúyo (Mas., Tic.); malagibúyo (Min., Cap.); malaigmó (N. E., Cam.); MALAIKMÓ (Zam., Bat., Lag., Tay., Min.); malasamát (Pamp., Bat.); malingaggók (Cag.); mañgongkóng (Neg.); manikbubúyo (Ilo.); maragauéd (Cag., N. V., Pang.); orátan, urátan (I. N., Abra); pay-ápa (Bat.); tabáu (Neg.); uaó, udayú (Sur.); ulaló (Cap.); ularóg (Cat.), uraróg (Cam.).

Wood moderately hard to hard; tough and somewhat difficult to split;

moderately heavy; sapwood and heartwood not distinct, light yellowish gray, in large trees inner part of heartwood with irregular ashy grayish or brownish streaks; grain somewhat crossed; texture variable, in some specimens rather coarse in appearance, but dense, in others fine and even glossy; seasons well; fairly easy to work. Durability III; not commonly attacked by insects.

Structure.—Pith rays moderately thick, distinct, in colored heartwood often filled with whitish deposits; pores small, scattered, sometimes with whitish deposits; soft tissue in very thin rings about pores and in fine concentric lines, mostly very irregular and interrupted, but at irregular intervals uniting into long continuous lines; growth rings indistinct, marked by ill-defined narrow belts of denser tissue.

Uses.—Used locally for beams, joists, rafters, etc.; not well known in Manila market, where it is found only among miscellaneous lumber; used for cheap and temporary construction, cheap furniture, box lumber, etc.

Supply.—Scarce, except for occasional stands in very limited regions.

Prices.—Sold in Manila only with miscellaneous stuff of a quality a little better than the cheapest lauans and other softer woods, about ₱50 per M.

The following are the only large and well-known species of *Celtis:*

C. luzonica Warb. MAGABÚYO.

A tree up to 110 centimeters in diameter; reported from: Cag., N. V., Bat., Lag., Tay., Cam., Cat., Min., Mas., Sam., Ilo., Cebu, Neg., Cota., Zambo.

C. philippinensis Blco. MALAIKMÓ

A tree up to 100 centimeters in diameter; reported from I. N., Abra, N. E., Pang., Zam., Bat., Pamp., Riz., Lag., Batg., Tay., Cam., Min., Tic., Ley., Neg., Dav., Zambo., Bas., Pal.

MORACEAE.

[Antipolo family.]

A very large family, but containing few important timber trees. The best known are malambingan, antipolo, anubing and nangka. The woods of the family are quite variable in color and mechanical properties. Most of them have rather conspicuous, often whitish, pith rays, and medium to large scattered pores. The woods of the genus *Ficus* (the "baletes" or wild figs) have generally conspicuous concentric bands of very loose-textured soft tissue.

Genus ALLAEANTHUS.

A. glaber Warb. MALAMBÍÑGAN.

A tree up to 60 centimeters in diameter; reported from: Cag., N. E., N. V., Pang., Mas., Mis., Dav., Bas.

Local names.—Alibabái (Cag.); alitagtág or balitagtág (Cam.); alokon, baeg, boñgon (Pang.); karud (Mis.); liba (Dav.); malakadiós (Mas.); MALAMBÍÑGAN (Bas.).

Wood soft to moderately hard; light to moderately heavy; sapwood whitish, rather sharply marked off from heartwood, newer heartwood bright red, older olive gray, but some logs are found almost all red, some almost all gray, and some irregularly streaked throughout; grain crossed in rather broad belts, making a distinct ribbon when quarter-sawn; texture rather coarse, but with a glossy appearance when surfaced with sharp tools; seasons very well; easy to work. Durability probably III, though

heartwood seems to be very rarely attacked by beetles; sapwood is very poor.

Structure.—Pith rays fine to moderately broad, distinct; pores medium to large, evenly scattered, some with glistening deposits; soft tissue only in very thin rings about pores; no growth rings.

Uses.—Interior finish; doors; furniture and cabinetwork; musical instruments.

Supply.—Limited.

Prices.—About ₱120 per M.

A. luzonicus Vid. HIMBABA-Ó.

A tree up to 45 centimeters diameter; reported from: Pamp. to Cam., Mas., Cota.

Local names.—Anabó (Mas.); babáian (Zam., Bat.); HIMBABA-Ó (Pamp., Riz., Man., Lag., Batg.); lanéte (Lag., Tay.). Wood practically identical with malambiñgan.

Genus ARTOCARPUS.

A genus of about 20 species, all timber trees, though not all equally common or large. The heartwood of all, though varying widely in mechanical properties, is bright yellow, darkening pronouncedly with age. Many species are widely distributed and well known, and nangka (the jakfruit tree), besides being very occasionally found wild, is cultivated in almost every province. The breadfruits, known as kamansí, rímas, ugób, etc., are cultivated varieties of antipolo. The woods fall rather distinctly into a harder and a softer class, which in commerce are known, respectively, as anubing and antipolo.

A. communis Forst. ANTIPÓLO.

A tree up to 90 centimeters diameter; reported from: I. S., Cag., Isa., Mtn., Zam., Bat., Riz., Lag., Min., Ley., Neg., Cebu, Guim., Bas., Pal.

Local names.—ANTIPÓLO (Bat., Riz., Man., Min., Pal.); kamansí (Ley.); pákak (I. S., Cag., Un., Zam.); tipólo (Cam., Neg.).

Wood soft to moderately hard; light, specific gravity 0.473 (Puigdulles); sapwood large (up to 6 or 8 centimeters), whitish, perishable; heartwood, when fresh, light yellow, turning yellowish brown; grain straight or somewhat crossed; texture rather coarse and rough; seasons well; not difficult to work, but dulls tools rapidly. Durability III; heartwood not attacked by beetles.

Structure.—Pith rays fine to moderately thick; often wavy, irregularly spaced, distinct; pores small to medium sized, irregularly scattered singly or in small clusters; soft tissue in irregular rings, or small, ill-defined patches about pores; growth rings none or very indistinct.

Uses.—Posts; beams, joists, rafters; ship building; flooring; ceiling; sheathing; doors; often substituted by musical instrument makers for nangka.

Supply.—Limited; rarely comes into Manila market.

Prices.—Generally sold mixed with cheap miscellaneous lumber selling at about ₱40 to ₱50 per M.

A. cumingiana Tréc. (Plate I, fig. 5.) ANUBÍNG.

A tree up to 100 centimeters in diameter; reported from: I. S., Cag., Isa., Mtn., N. E., Tar., Un., Zam., Riz., Lag., Cam., Alb., Sor., Min., Mas., Tic., Neg., Ilo., Sib., Sur.

Local names.—ANUBÍNG (N. E., Tar., Riz., Lag., Tay., Cam., Min., Sib.); anublíng or kanublíng (Cam., Alb., Sor.); bayukó (Neg., Ilo.); indáng

(Lag., Riz.); is-ís (Neg.); kalauahan (Bont.); kamandág (Cag.); koliúng (Abra); kúbi (Tay., Min., Mas., Tic., Neg., Sur.); ubién (I. S., Cag., Isa., Mtn.).

Wood hard; heavy, specific gravity 0.861 (Puigdulles); sapwood 3 to 5 centimeters thick, whitish, perishable; heartwood yellow when fresh, turning to dark brown or, when exposed, to greenish black; grain somewhat crossed; texture dense, but rough; slight disagreeable odor when fresh; checks little, but is liable to warp if not carefully seasoned; difficult to work, dulling tools very rapidly. Durability I; rarely attacked even by termites.

Structure.—Much like antipolo, but with more abundant whitish deposits in pores and pith rays, and growth rings generally bounded by a narrow belt of denser and darker tissue.

Uses.—Piling; ship, wharf, and bridge building; poles; posts; beams, joists, rafters; mine timbers; ties; paving blocks.

Supply.—Limited.

Prices.—One hundred and eighty pesos to ₱185 per M.

A. integrifolia L. f. NANGKÁ.

A tree up to 45 centimeters or more in diameter, the bole often short and irregular; widely distributed and commonly cultivated; both wild and cultivated forms always known as NANGKÁ or langká.

Wood denser and of smoother texture than antipolo, but not so hard nor so difficult to work as anubing and does not dull tools so rapidly.

Structure.—Similar to antipolo, but with conspicuous, irregularly spaced, narrow, concentric bands of soft tissue.

Uses.—A favorite for musical instruments; furniture and cabinet work; saw frames and tool handles; inlaying.

Supply.—Very limited.

Prices.—Rarely, if ever, comes to market as saw timber; cabinet workers and musical-instrument makers acquire logs or short bolts by bartering musical instruments for them, or buy them at prices not exceeding about ₱15 per cubic meter.

A. lamellosa Blco. KÚBI.[1]

A tree up to 65 centimeters in diameter; reported from: Cag., Pang., Bat., Cav., Tay., Cam., Min., Tab.

Local names.—Anubíng (Bat., Cav.); hamigí (Cam.); kalulot (Min.); KÚBI (Tay., Min., Tab.); lanusi (Cag.); sulípa (Bat.); ubién (Pang.).

Wood in all respects like anubing, except that it is, on the average, a little lighter and softer. No doubt part of the commercial anubing is furnished by this species.

A. lanceolata Tréc.

A tree up to 95 centimeters in diameter; reported only from Bataan and Sorsogon, with local name kubi in latter province. Wood like anubíng.

A. ovatifolia Merr.

A tree up to 40 centimeters in diameter; reported from Laguna and Camarines, with local name tipólo in latter province. Wood like antipólo.

A. rubrovenia Warb.

A tree up to 40 centimeters or more in diameter; reported from: Cag., Isa., Pang., Bat., Riz., Lag., Tay., Cam., Sor., Min., Sulu Arch.

Local names.—Anubíng (Bat., Lag., Tay.); anablíng, anobilíng, anu-

[1] This must not be confused with malacadios, which is also known as kubi in parts of Mindanao and the Bisaya Islands.

blíng, etc. (Riz., Cam.); bungá (Cag.); hamigí, kalulót, (Min.); kúbi (Sor., Min.); tumulubo (Isa.); ubién (Pang.). Wood of the anubíng type.

A. subrotundifolia Elm.

A tree up to 40 centimeters in diameter; reported from: Tay., Sor., Sam., Ley., Agus.

Local names.—Buragit (Agus.); kúbi (Tay., Sam., Ley.); lukóan (Sor.). Wood of anubing type.

A. superba Becc.

A tree up to 75 centimeters in diameter; reported only from Zamboanga and Basilan; local name pikpik-uág (Bas.).

No wood specimens have been collected, but Foxworthy (Indo-Malayan woods, p. 447) states that the wood of this species is of the anubing type, and the writer has seen large logs of a very hard, heavy kind of anubing in Zamboanga mills.

A. treculiana Elm.

A tree up to 100 centimeters in diameter; reported from: Bab., Bats., Lag., Tay., Cam., Min., Guim.

Local names.—Antipólo (Tay., Min.); pákak (Bab.); tipólo (Cam., Guim.); tipúho (Bats.).

No wood specimens are known, but the local names permit little doubt that it is of the antipolo type.

Genus FICUS.

More than 160 species of this genus (the wild figs) are reported from all the islands and provinces in the Archipelago. A very large proportion of them have the "balete" habit; that is, they start from seed dropped on other trees, whence they send down roots to the ground, finally entrapping and often killing the host. Others, however, grow directly from the ground, forming tall, straight trunks. The wood of practically all species is soft, light and very perishable, being equally subject to attacks of fungi and of insects. The structure of the woods of the genus is characterized most frequently by very regular and conspicuous, broad concentric bands of very loose-textured, soft tissue. They are used only for the most ordinary purposes and are marketed only mixed with the cheapest miscellaneous lumber.

Genus GYMNARTOCARPUS.

G. woodii Merr. MALANANGKÁ.

A tree up to 85 centimeter in diameter; reported from: Cag., Zam., Bat., Lag., Cam., Min., Ley., Sam.

Local names.—Anubíng-kadiós, anubíng na nangká' (Lag.); bayukó' (Cam.); bíga (Sam.); buratu (Cag.); malabokbók (Zam.); MALANANGKÁ' (Bat., Lag.); páñgi (Zam.); sulípa (Bat.); tabulí (Cam.).

Wood very much like that of many species of *Ficus;* yellowish white when fresh, but almost always staining to bluish gray; light; soft; very perishable; found in the market only mixed with cheap miscellaneous lumber.

Genus TAXOTROPHIS.

T. ilicifolia Vid. (Plate I, fig. 6.) KUYUSKÚYUS.

A tree up to 30 centimeters in diameter; reported from: Lag., Tay., Cam., Min., Neg., Cebu, Mis., Zambo., Bas., Pal.

Local names.—Dagpít (Occ. Neg.); dáyap-amó' (Pal.); gúlus (Min.);

kuliskúlis (Pal.); kuruskúrus (Cam.); KUYUSKÚYUS (Lag., Tay., Cam., Min.); malalimón (Zambo.); suting-gimba (Bas.); talingáan (Cebu).

Wood very hard; very heavy; sapwood clear pale yellow; heartwood very irregular in outline and capriciously mottled with brown, greenish and blackish streaks, sometimes with numerous, small, irregularly scattered blackish spots; grain straight; texture very fine and dense, glossy; seasons very slowly, without much splitting or warping; hard to saw, but not difficult to surface, taking a glossy finish under sharp tools. Durability II; sapwood apparently little, if at all, inferior to heartwood; even wood from small trees not attacked by beetles.

Structure.—Pith rays numerous, fine, but distinct, often wavy; pores few, small, scattered, inconspicuous, in heartwood with whitish deposits; soft tissue the most conspicuous feature, in numerous (5 to 8 to the millimeter) wavy, often branching, concentric lines of variable thickness, on the whole occupying nearly half the total area; growth rings absent or very irregular and indistinct.

Uses.—Tool handles; cabinetwork and inlaying; musical instruments; a favorite for canes; would probably be good for bobbins and shuttles.

Supply.—Very limited.

Prices.—Probably never comes into market as saw timber; provincial cabinetmakers acquire logs or bolts by barter for occasional jobs; musical-instrument makers in Manila would pay not to exceed ₱15 to ₱20 per cubic meter.

OLACACEAE

[Tamayuan family.]

A family containing, in the Philippines, only a single timber tree, tamayuan.

Genus STROMBOSIA.

S. philippinensis Rolfe (Plate I, fig. 7.) TAMAYÚAN.

A medium-sized tree, up to 50 centimeters in diameter; reported from: I. N., Cag., Isa., Bul., Batg., Lag., Tay., Cam., Alb., Sor., Min., Mas., Sam., Ley., Neg., Lan., Zambo., Bas.

With exception of larak (Isa.), local name everywhere TAMAYÚAN, kamayúan, or similar forms.

Wood hard but brittle; heavy; sapwood 5 to 7 centimeters thick, whitish, not durable, generally sharply distinguished from heartwood; heartwood pinkish brown to dark reddish brown, sometimes with ill-defined and rather irregular lighter and darker bands; grain straight or slightly crossed; texture very fine, dense and smooth; seasons with little warping, but subject to internal checking in logs or large pieces; easy to work, taking a very smooth, silky surface under a sharp plane. Durability at least II; rarely, if ever, attacked by beetles.

Structure.—Pith rays numerous, very fine, straight and regular; pores numerous, very small, evenly scattered; soft tissue inconspicuous, surrounding pores and forming extremely fine, irregular, transverse lines between pith rays; growth rings, if present, marked only by a belt of slightly denser, darker tissue; all elements of unusually uniform color.

Uses.—Poles; piles, posts; beams, joists, rafters, and studs; ties; mine timbers; ax handles; chisel and similar tool handles; canes; flooring; window sills; furniture and cabinetwork.

Supply.—Scarce; rare as saw timber; probably more tamayuan has

has been brought to the Manila market in recent years in hewn ties than in any other form.

Prices.—Ties ₱1.25 to ₱1.50 each; saw timber has no established price, but occasional lots of boards or dimension stuff would bring at least ₱100 per M.

ANONACEAE.

[Ilang-ilang family.]

A family containing no important timber trees, but noted for the ilang-ilang tree, the source of the famous perfume, and furnishing, besides, a number of small to medium-sized trees, whose wood is frequently used locally and is easily recognized by its very characteristic structure. The pith rays are moderately thick and conspicuous, and between them are numerous, generally conspicuous, very regular crossbars of soft tissue giving a ladder-like appearance to the wood in cross section.

Genus CANANGIUM.

C. odoratum Baill. (Plate I, fig. 8.) ILANG-ÍLANG.

A tree up to 75 centimeters in diameter; found, either wild or in cultivation, in almost every island and province.

Local names.—Alañgígan (Lep.); anañgílan, anañgíran (Sur.); aranígan (Abra); ILANG-ÍLANG (I. S., Zam., Bat., Riz., Man., Lag., Tay., Min., Mas., Pal.); ñgíran (Agus.); tañgíd or tañgít (Cam., Alb., Sor.).

Wood light; soft to moderately hard; nearly white when fresh, but turning gray or light brown in seasoning; no distinct heartwood; grain straight; texture rather coarse; works very easily. Durability IV, but apparently not attacked by insects.

Structure.—Pith rays not very numerous, very conspicuous, rather variable in thickness; pores not numerous, small to moderately large, evenly scattered, sometimes in small radial strings of 2 to 4; soft tissue forming very numerous, slightly wavy, parallel, concentric lines making a ladder-like pattern with the pith rays.

Uses.—Used locally for light household implements; posts and other structural parts of light houses in the country; scabbards.

Supply.—Scarce; never brought to Manila as saw timber.

Genus CYATHOCALYX.

C. globosus Merr. DALÍNAS.

A medium-sized tree up to 50 centimeters in diameter; reported from: I. N., Cag., Beng., Bat., Tay., Cat., Neg.

Local names.—Alínau (I. N.); bohókan (Cat.); DALÍNAS (Bat.); damarau (Neg.); lanútan (Bat., Tay); latauán or latuán (Bat.,); malatapái (Neg.).

Wood heavy; hard; flexible and tough; sapwood 10 to 15 centimeters thick, pale yellow, often turning light gray in seasoning, sharply distinguished from heartwood; heartwood dark purplish brown, often with stony deposits in old heart cracks, and with a distinct odor of old leather. Durability of sapwood poor, of heartwood excellent.

Structure.—Very much like preceding, but all elements somewhat finer, denser in appearance and more sharply defined; occasional white deposits in pores.

Uses.—House posts and other structural parts; household implements; agricultural implements; cabinetwork; canes.

Supply.—Scant.

Prices.—Brought to market only mixed with cheap miscellaneous lumber selling at ₱40 to ₱50 per M.

The WHITE LANUTANS.

A large number of species of this family, belonging to the genera *Alphonsea, Goniothalamus, Mitrephora, Orophea, Phaeanthus, Polyalthia, Popowia, Saccopetalum, Sageraea, Xylopia* and perhaps others, are found in all parts of the Islands. The name lanutan or white lanutan is very generally applied to these trees, which should not be confused with the lanutan (*Bombycidendron* spp.) of the family Malvaceae. They are much alike in general character, being light to moderately heavy, soft to moderately hard, of rather fine texture and straight grain, whitish, pale yellow or light brown, staining easily in drying, sometimes having a small, irregular, dark-colored heartwood. They all have in cross section the conspicuous ladder-like pattern of soft tissue characteristic of the family. Most of them are not very durable in contact with the ground or exposed to weather, but are not commonly attacked by insects. They are used locally for house construction and minor articles. They are rarely seen in commerce except in mixed lots of miscellaneous lumber.

MYRISTICACEAE.

[Duguan family.]

A family of small to medium sized trees, very widely distributed, and generally well known in all regions on account of the red sap (*dugú,*' "blood"), whence are derived many of the local names of the trees, but of little importance on account of the very poor quality of the woods of almost all species.

Genus KNEMA.

A genus of about 10 species, only one of which seems to be widely distributed and of fairly large size, the others being of very limited distribution and rarely reaching over 30 centimeters diameter.

K. heterophylla Warb. TAMBALÁU.

A tree up to 60 centimeters in diameter, straight but not very tall; reported from: Bab., Cag., Isa., Beng., N. V., Tar., Bat., Riz., Lag., Tay., Cam., Alb., Ley., Neg., Cebu, Sur., Zambo.

Local names.—Dagdagáan (Cag.); dílang-butikí (Lag.); dugúan (Bat., Zam., Tay., Cam., Alb., Tic., Ley., Cebu, Neg.); dumadára (Cag.); durugú' (Lag.); lapák (Lag.); margabólo (Riz., Lag.); parug-án (Riz.); TAMBALÁU (Bat.).

Wood soft; light; sapwood and heartwood scarcely or not at all distinguishable; pale red or pinkish, generally turning in seasoning to very light brown; grain straight; texture fine, even; seasons with little checking or warping, but liable to stain badly; very easy to work. Durability IV; sapwood always and heartwood very frequently attached by beetles.

Structure.—Pith rays numerous, fine, distinct; pores few, medium sized, scattered, or in very short radial rows; soft tissue in thin rings about pores and forming a conspicuous light-colored line at the beginning of the growth rings; these lines also make a conspicuous figure on longitudinal (especially tangential) sections, where they appear darker than the surrounding tissue; growth rings not otherwise marked by any difference in color or structure.

Uses.—Light and temporary construction; cheap furniture; kitchen and other household utensils; cheap cigar boxes; boxes; dry measures; ties on logging railroads.

Supply and prices.—Rarely marketed under its proper name; small quantities found mixed with the cheapest grades of miscellaneous lumber.

Genus MYRISTICA.

A genus of about 18 species, of which only three or four seem to be widely distributed, or to reach a diameter of more than 40 centimeters.

The local names are applied to all species without any distinction and are therefore given altogether for the whole genus.

Local names.—Alanígi (Zambo.); barakbák (Pang.); burnúd (Zambo.); dílañg-butikí (Lag.); DUGÚAN or dug-án (Zam., Bat., Riz. Lag., Tay., Cam., Min., Mas., Tic., Sib., Sam., Neg., Ilo., Sur., Lan., Bas., Pal.); duhau (Zambo.); durugú', hindurugú' (Bat.); lágo' (Bas., Pal.); láho' (Cul.); mabúlo, malamabúlo (Pang.); mabúlong-gúbat (Zam.); manumbága (Zambo.); pálong (I. S.); pariá (Bat.); tálang-bundók (Tay.); talihágan (Cag.); tambaláu (Zam., Bat., Lag.); tambáu (Bat.); taratára (Tay.); ugáu (Cam.).

The woods of the different species cannot be distinguished from each other nor even with certainty from those of the preceding genus, practically the only difference between *Knema* and *Myristica* being that the latter is of a more decided light red, which becomes slightly darker in seasoning if the wood is dried quickly enough to prevent staining.

Uses, supply, and prices.—As for tambalau.

The following are the most important species of *Myristica*:

M. guatteriifolia A. DC.

A tree up to 60 centimeters in diameter; reported from Bab., Cag., Beng., Pang., Bat., Tay., Cam., Min., Ley., Mas., Sib., Ilo., Cul., Zambo., Bas., Pal.

M. mindanaensis Warb.

A tree up to 50 centimeters in diameter; reported from: Mis., Lan., Zambo., Bas.

M. philippensis Lam. (Plate II, fig. 9.) DUGÚAN.

The largest among the widely distributed species, and the best known; up to 80 centimeters in diameter; reported from: I. N., I. S., Cag., Abra, N. E., Pang., Pamp., Zam., Bat., Riz., Lag., Batg., Tay., Cam., Min., Ley., Bas.

M. simiarum A. DC.

A tree up to 80 centimeters in diameter; reported from: Bat., Tay., Cam., Sur., But.

LAURACEAE.

[Baticulin[1] family.]

A large family, containing a number of small or medium sized and at least one large tree (tambulian), but very imperfectly known, both botanically and as regards the woods. The best known individual species are malacadios, kalingag, dugkatan and tambulian, while a number of other species of several genera can be roughly classified in two groups, the white baticulins and the yellow baticulins.

White baticulin seems to be derived only from *Litsea perrottetii* and some other species of the same genus; yellow baticulin is furnished by several species of *Litsea*, *Dehaasia*, *Machilus*, *Neolitsea*, *Nothophoebe* and *Phoebe*. Of the very numerous species of these genera, the woods are known

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[1] The Spanish pronunciation and spelling of the native batikulíng.

only in part and the individual species described below are the best known and most widely distributed.

Genus BEILSCHMIEDIA.

B. cairocan Vid. (Plate II, fig. 10.) MALACADIÓS.

A tree up to 90 centimeters in diameter; straight but not tall.

Local names.—Anagép (I. N., Cag.); anagó-n͠gisí (Cag.); duláuen (Cag., Isa.); kairúkan (Zam.); kalan͠gigíng (I. S.); kúbi (Zambo., Bas.); makatu (Palaui); MALACADIÓS (Tay.); nagúsip (Ant.); níket (I. N.); takkí na gayáng (Cag.).

Other names recorded for specimens not specifically determined as *B. cairocan,* but having wood of apparently identical character are: Bani-báni (Agus.); inyám, putían (Occ. Neg.).

Wood moderately hard; moderately heavy; sapwood 1.5 to 4 centimeters thick, pale golden yellow, rather sharply marked off from heartwood; heartwood from a shade darker than sapwood to light golden brown, darkening somewhat with age; grain slightly crossed in narrow bands; texture fine, dense, glossy; strong odor when fresh, similar to that of aromatic vinegar; seasons well; easy to work. Durability I, even sapwood rarely attacked by insects.

Structure.—Pith rays numerous, fine, distinct; pores numerous, small to medium, evenly scattered, many with glittering deposits (probably tyloses); soft tissue inconspicuous, in very small patches about pores; growth rings marked by a very narrow belt of darker, denser tissue.

Malacadios is very similar to the yellow baticulins, but is harder, heavier, of finer texture and on the average somewhat darker in color. It is probable that some malacadios is accepted by the sculptors as baticulin.

Uses.—Poles; ties; bridge, wharf, and shipbuilding; posts; sills; beams, joists, and rafters; floors; window sills; doors; ceiling and sheathing; siding; oars and paddles; carving; household implements.

Supply.—Widely distributed, but rather scarce.

Prices.—About ₱120 per M. when brought to Manila from Zamboanga mills.

B. glomerata Merr. TERÚKAN.

Reported only from Ilocos Sur, Laguna and Bataan; wood appears to be somewhat softer and lighter in color and weight than the preceding.

Several other species are reported, but no local names are on record and no wood specimens known.

GENUS CINNAMOMUM.

C. mercadoi Vid. KALÍN͠GAG.

A small to medium sized tree, up to 65 centimeters in diameter, generally straight, but not very tall; very widely distributed and well known, but rather scarce. Beside the almost universal KALÍN͠GAG, also known as: kaníla (from Span. *canela,* cinnamon); kulíuan or ulíuan (Cag.); samíling or simíling (Bat.).

Wood soft to moderately hard; light to moderately heavy; sapwood large (up to 10 or 12 centimeters), light brown; heartwood irregular in outline, very irregularly mottled with light and dark brown to blackish streaks; both bark and wood with strong and lasting odor, almost exactly like sassafras; warps badly unless very carefully seasoned; easy to work. Durability where exposed unknown, but otherwise at least II; never attacked by beetles, but rapidly destroyed by termites.

Structure.—Pith rays fine, numerous, rather indistinct; pores small to medium, scattered; soft tissue inconspicuous, scattered; no growth rings.

Uses.—Used locally for beams, flooring, etc., in small houses; household implements, carved articles; would make an excellent material for lining wardrobes, moth-proof chests, etc.

Prices.—Scarcely, if ever, found in regular lumber markets.

C. mindanaense Elm. MINDANAO CINNAMON.

Reported only from various points in Mindanao as a source of cinnamon bark, identical in appearance and flavor with other commercial cinnamons; the wood is similar to kalingag in appearance and structure, but with odor resembling cinnamon rather than sassafras.

GENUS CRYPTOCARYA.

Contains 25 or more species of medium-sized trees, of which only one is well known.

C. bicolor Merr. DUGKÁTAN.

Reported only from Lanao, Cotabato and Sulu, with above name; a medium-sized tree, up to 40 centimeters or more in diameter.

Wood moderately hard; moderately heavy; sapwood 8 to 12 centimeters thick, yellowish, sharply distinguished from heartwood; heartwood dark greenish brown; grain straight; texture fine, smooth; seasons well; easy to work. Durability II.

Structure.—Pith rays fine, distinct; small to medium, scattered; soft tissue in small patches about pores and in narrow, irregularly spaced, concentric lines; growth rings irregular and indistinct, or marked by a fairly distinct narrow belt of soft tissue.

Uses.—House posts; beams, joists, rafters; flooring; cabinetwork; household implements.

Prices.—Cut only locally and rarely, if ever, reaches regular lumber markets.

The numerous other species reach from 40 to 65 centimeters in diameter, but as far as known have even less heartwood than dugkatan. They are used locally for interior structural timber, most of them being little esteemed where severely exposed. Nearly 40 local names are recorded, so many of which are also applied to species of entirely different families that they furnish practically no guide to knowing the trees.

GENUS DEHAASIA.

Two or three species, of which only one is well known; the wood of the other species seems to be practically identical, and a few of the local names applied to them are included in the list given for margapali.

D. triandra Merr. MARGAPÁLI.

Local names.—Anagá', bañgúlo, basláyan (Min.); bétis (Sib.); kabúro, maníhai (Min.); MARGAPÁLI (Lag.); mompón (Cam.); paitán (Lag.); putían (Neg.).

Wood of the "yellow baticulin" type, and would no doubt be accepted as such by the sculptors of Manila; moderately hard; light to moderately heavy; sapwood 3 to 5 centimeters thick, pale yellow, rather sharply marked off from heartwood; heartwood rich golden yellow, darkening slightly on exposure; grain very straight; texture fine, dense, glossy;

faint aromatic odor when freshly worked; seasons well; very easy to work. Durability II; even sapwood rarely attacked by beetles.

Structure.—Pith rays fine, distinct; pores small to medium sized, scattered; soft tissue inconspicuous, in thin rings or small patches about pores; growth rings very indistinct or entirely absent.

Supply and prices.—When marketed in Manila, sold as baticulin, (see p. 111).

Genus EUSIDEROXYLON.

E. zwageri Teys. & Binn. (Plate II, fig. 11.) TAMBULÍAN.

A tall, straight tree, up to 110 centimeters in diameter, reported only from Tawi-tawi, with above name. The billian or Borneo ironwood tree.

Wood very hard; very heavy; sapwood small, scarcely distinguishable; heartwood yellowish brown when fresh, turning very dark brown with age; grain straight; texture fine, somewhat glossy; shrinks, warps, and checks very little; for a very hard wood, not difficult to work. Durability I; in Borneo considered the best wood for house posts and piling; even sapwood not attacked by insects.

Structure.—Pith rays fine; pores medium to large, scattered singly or in small groups, frequently with glittering deposits; soft tissue conspicuous, in irregular patches about pores, often confluent so as to form irregular, branching, broken and wavy tangential lines; no growth rings.

Uses.—Piles; posts; poles; ties; bridge, ship, and wharf building; paving blocks; all sorts of high-grade, strong construction; ax and other tool handles; axles; shafts; hubs, spokes, and felloes; flooring and stairs; window sills; cabinetwork.

Prices.—Has never been cut for the market; if marketed, should be worth, on account of its great strength and extreme durability, at least as much as the best ipil.

Genus LITSEA.

A genus of 35 or more species, of which only a few are fairly well known. The woods are of three rather distinct types, which are represented best by sablot (*L. glutinosa*), baticulin (*L. obtusata*), and marang (*L. perrottetii*), the latter also known as white baticulin.

The various local names seem to bear little relation to the character of the wood, the same names being found in various regions, or even within the same province, for trees having woods of quite distinct qualities. They are therefore given, to avoid repetition, for the whole genus regardless of species.

Local names.—Anagép (N. V.); anagós (Min.); aráhan (Sam.); asasalá (Bal.); bagariláu (Tay.); BAKÁN (Lag., Batg., Tay., Cam., Min., Sam., Ley., Neg., Buk.); bakán-kalaánan (Min.); balañgánan (Min.); balangód (Cam.); BAÑGÚLO (Min.); basiláyan (Sib.); batikulíng or BATICULÍN (Cag., Isa., Bat., Riz., Lag., Batg., Min.); búlus (Bat.); duláuen (Cag., Isa.); dunggói (Riz.); gibuáya (Lag.); hindáng (Cag., Ley., Sur.); iddáng, indáng (Cag.); ilang-ílang-gúbat (Lag.); ilang-ílang-laláki (Riz.); kalaítik (Min.); kubílan (Beng.); lanat (Mas.); magilík, malasíko (Bat.); malatugon (Isa.); MÁRANG, with various qualifying words (Lag., Tay., Pol., Cam., Alb.); MATÁNG-USÁ (Lag.); mapipí (Tic.); olos-ólos (Pang.); pamalitién (Pang.); pamayabásen (Cag.); parasablút (Zam.); pusopúso (N. E., Pamp., Bat., Riz., Lag., Batg., Min.); SABLÓT (I. S.); tagutugán (Cam.); tikám (Bat.); tubhás (Bats.).

L. euphlebia Merr. MATÁNG-USÁ.

A tree up to 35 centimeters in diameter reported only from Tayabas; wood rather loose textured, pale golden yellow, similar to baticulín (*L. obtusata*); perhaps a source of the baticulín of the sculptors.

L. fulva F.-Vill.

A small tree, reported from: N. Luz. to Tay., Min., Neg., Mis., and Zambo., without local names.

Wood fine textured, pale golden yellow, very similar to baticulin; would certainly be accepted by sculptors as such.

L. garciae Vid. BAÑGÚLO.

A tree up to 60 centimeters in diameter, reported from Lag. to S. Luz., Min., Sam., Ley., Cota.

Wood a rather coarse textured white baticulin, practically identical with marang (*L. perrottetii*).

L. glutinosa C. B. Rob. SABLÓT.

A tree up to 60 centimeters diameter, reported from N. Luz. to Cam., Min., Mas., Ley., Neg., Guim., Pal.

Wood unlike the baticulins, rather closely resembling in hardness, weight, and texture that of malacadios (*Beilschmiedia cairocan*), though somewhat lighter in color and without the acid aromatic odor; it would probably pass for malacadios in the market and on account of its weight, hardness, and lack of characteristic odor, would probably not be accepted by the sculptors as baticulín.

L. luzonica F.-Vill.

A small tree, up to 30 centimeters in diameter, reported from N. Luz to Tay., Min., Sam., Neg., Mis., Lan., Zambo., and Pal., but evidently not well known, as the names reported for it are almost invariably taken from other trees resembling it externally.

Wood of fine texture somewhat similar to sablot (*L. glutinosa*), with small, grayish or brownish heartwood, and no pronounced odor. Would probably not be accepted by sculptors, though undoubtedly a good wood.

L. obtusata F.-Vill. BATICULÍN.

A tree up to 40 centimeters (and probably more) in diameter; reported only from Zam., Bat., Neg., and Bas., but probably one of the sources of the yellow baticulin of the sculptors of Manila, who have always obtained a great part of their supply from Bataan and Zambales.

Wood soft to moderately hard; light; sapwood 1 to 3 centimeters thick, pale yellow, generally turning to a pale yellowish or greenish brown in seasoning, not very sharply marked off from heartwood; heartwood bright golden yellow when fresh, darkening somewhat with exposure; faint odor reminding one both of cedar and camphor; grain straight; texture fine, with a smooth waxy feel, taking a glossy cut under sharp tools; seasons well; very easy to work. Durability II; even sapwood rarely attacked by insects.

Structure.—Pith rays fine, but distinct; pores medium sized, evenly scattered; soft tissue inconspicuous, in very thin rings about pores and a very thin indistinct line at end of growth ring.

Uses.—Carving and sculpture, especially of sacred images, for which the baticulins (taking this in the commercial sense, as including all the yellow baticulins not only of this species, but of the other species furnishing similar wood) are considered the best of all Philippine woods; panel-

ing for doors, altars, wardrobes, carriages; ceiling and sheathing; musical instruments; cabinetwork; pyrography.

Supply and prices.—There is no regular supply of sawn lumber at all in the Manila market. The Chinese shops get an occasional log, which they either sell whole to sculptors, or saw to order for paneling, picture framework, etc. But the greater part of their supply the sculptors purchase direct from the loggers at prices amounting to about ₱18 to ₱20 per cubic meter.

L. perrottetii F.-Vill. (Plate II, fig. 12.) MÁRANG.

A tree up to 45 centimeters or more in diameter; reported from: N. Luz. to Cam., Min., Sam., Ley. and Neg.

Wood light and soft; sapwood and heartwood scarcely distinguishable, creamy white, easily staining to greenish gray or light brown if not rapidly seasoned; grain somewhat crossed in broad belts; texture rather coarse, but taking a smooth and somewhat glossy surface under sharp tools; except for staining, seasons very well; very easy to work. Durability somewhat inferior to baticulin; occasionally attacked by insects.

Structure.—Pith rays rather numerous, fine to moderately thick, conspicuous; pores medium sized, scattered, often partitioned, tending to form a rough pattern of diagonal lines; soft tissue in thin rings or small, irregular patches about pores, distinctly of two colors, the rings being of the same pale straw color as the pith rays, but inclosing small dots of deeper yellow; no growth rings.

Uses.—Except for statuary, about the same as baticulin; when cut with miscellaneous lumber, sold with the white lauans.

Supply and prices.—The supply is scant and irregular and the wood is rarely sold under its own name.

L. philippinensis Merr. BAKÁN.

A tree up to 50 centimeters diameter; reported from: Zam., Bat., Cam., Ley., Min., Sib., Mis., Bas.

Wood very similar to baticulin (*L. obtusata*) and if brought to Manila market would undoubtedly be accepted as such.

L. tayabensis Elm.

A tree up to 30 centimeters diameter; reported from: Lag., Tay., Min., Neg., Dav. Wood similar to that of sablot (*L. glutinosa*).

Genus MACHILUS.

A genus of four known species of small to medium sized trees, of which *M. philippinensis* is the largest and best known.

M. philippinensis Merr.

A tree reaching ordinarily 60 to 70 centimeters diameter, but one of 130 centimeters reported from Batangas; reported from Bat., Lag., Batg., Tay.

Local names.—Margapáli-kulilisiáu (Lag.).

Wood of the "yellow baticulin" type, believed to furnish a large part of the commercial baticulin of the carvers and cabinetmakers in Laguna, especially the Paete region. Possibly some of it also reaches Manila shops.

Genus NEOLITSEA.

A genus of small to medium-sized trees, of about 10 species, of which only one, pusopuso, is well known. The others are less widely distributed and scarcer, and almost no local names recorded for them.

N. vidalii Merr. PUSOPÚSO.

Local names.—Lanat (Guim.); lanútan-putí (Min.); márang (Lag.); poli (Cag.); PUSOPÚSO, with various abjectives (Bat., Riz.); also reported without local names from: Tay., Min., Agus., Dav., Bas.

Wood moderately hard; moderately heavy; sapwood large, irregular, pale yellow turning to grayish brown; outer heartwood scarcely darker, inner heartwood dark greenish brown, with curious belts and mottlings of lighter and darker tints; grain straight or somewhat crossed; texture fine, very smooth, glossy; seasons well; works easily. Durability probably as good as baticulin. It is possible that, when containing little or no brown heartwood, this furnishes part of the baticulin of sculptors.

Structure.—Pith rays numerous, fine, pores small, evenly scattered; soft tissue inconspicuous; beginning of growth rings marked by narrow bands of lighter colored tissue.

Supply and prices.—Practically unknown in Manila market.

Genus NOTHOPHOEBE.

N. malabonga Merr. MALABUÑGA.

A tree up to 75 centimeters in diameter, reported from: N. Luz. to Cam., Min., Ley., Neg.

Local names.—Anagáp (Bul.); duláuen (Cag.); kabúlo (Min.); MALABUÑGA (Lag.); malay-á (Cam.); margapáli (Lag.).

Wood one of the best types of yellow baticulin, though without pronounced aromatic odor of *Litsea obtusata;* soft to hard; light; sapwood about 5 centimeters thick, pale yellow, generally staining in drying to a greenish gray or brown, rather sharply distinguished from heartwood; heartwood deep golden yellow or orange, darkening somewhat on exposure; grain somewhat crossed; texture moderately fine, very smooth and glossy, with a waxy feeling; seasons very well; exceedingly easy to work, a sharp tool cutting it as smoothly as cheese, even square across the grain. Durability II; even sapwood rarely attacked by insects.

Structure.—Pith rays numerous, fine, fairly distinct; pores numerous, often partitioned, sometimes in a rough pattern of diagonal rows, sometimes in crowded radial rows of 3 to 6; soft tissue in small, roughly defined patches about pores, often confluent in diagonal lines and about radial groups; no growth rings.

Uses, supply, and prices.—Same as baticulin (*Litsea obtusata*). Also used in Laguna Province for house construction.

Genus PHOEBE.

P. sterculioides Merr. KABÚRO.

A tree up to 75 centimeters diameter.

Local names.—Banógan (Sam.); banúyo (Neg.); batikulíng (Min.); bokbók (Cap.); búgo (Lan.); KABÚRO (Min.); kúbi (Neg.); magbuábang (Sur.); margadiláu (Lag.).

Wood a good type of yellow baticulin; soft to moderately hard; light; sapwood small, slightly lighter colored than heartwood, not so commonly staining as in malabunga; grain straight or slightly crossed; texture, seasoning, and working qualities as in malabunga, though slightly harder.

Structure.—Very similar to malabunga, but soft tissue less abundant.

Uses, supply, and prices.—Same as baticulin.

ROSACEAE.

[Liusin family.]

A family represented in the Philippines by only two genera of timber trees.

Genus PARINARIUM.

A genus of about five species, of which only one is widely distributed. The wood of all species is practically identical; the same local names are applied to all indifferently, and are here given for the whole genus.

Local names.—Aningát (I. S.); bakáyau (Pang.); bárit (Cam., Sam.); binggás, binggáu (I. N., Pang., Tar.); boñgóg (Sam.); botábon (Pal.); duñgon-duñgónan (Tay.); gimaimaí (Lan.); ginániang (Riz., Batg., Tay.); kagemkém (I. S.); kamulitiñgan (Pamp.); kangkáñgan, kapgáñgan (Dav.); karatákat (I. N., I. S., Cag.); kulatiñgan or kulitiñgan (N. E., Tar.); langkáñgan (Lan.); lañgóg or lañgóog (Agus.); laiúsin (Pamp., Cam., Lag.); LIÚSIN (N. E., Zam., Bat., Lag., Cam., Min.); lumuluás (Cota.); malaígang (Sam.); malapíga, malapúyau (Tay.); maluklík (Zambo.); mantalína or mantalíñgan (Zambo.); matamatá (Ley.); pantóg-usá (Pal.); pásak (N. E., Man. lumber yards); sábongkaág (I. S.); salifúñgan, salutin (Cag.); saráñgan (Sam.); sigaadan (Cota.); TABON-TÁBON (Alb., Sur., Agus.); takdáñgan (Min.); tapgás (Guim.); uas-uása (Cag.).

The following are the best known species of *Parinarium*:

P. corymbosum Miq. (Plate II, fig. 13.) LIÚSIN.

A tree generally from 60 to 90 centimeters in diameter, but one recorded from Bataan of 160 centimeters; reported from: Cag., I. N., I. S., Isa., Abra, N. E., Pang., Pamp., Tar., Zam., Bat., Riz., Lag., Batg., Tay., Cam., Min., Mas., Sam., Ley., Guim., Agus., Lan., Dav., Cota., Zambo., Pal.

Wood hard; very heavy; sapwood and heartwood scarcely distinguishable, pale red; heartwood sometimes streaked with very narrow, widely separated, dark belts which do not at all follow the growth rings; faint acid odor; grain straight or slightly crossed, often with a characteristic regular wave; texture dense and fine, but with conspicuous pores; seasons without much checking, but warps considerably; very difficult to work, being notorious for the rapidity with which it dulls all tools. Durability in contact with ground or exposed to weather poor, but one of the best woods known as regards resistance to teredo, and also very rarely attacked by insects.

Structure.—Pith rays fine; pores few, medium sized to large, oval, irregularly scattered; soft tissue forming numerous wavy, concentric lines; growth rings indistinct, marked by a narrow band of slightly denser, darker tissue.

Uses.—Salt water piling (tops should be given, as soon as possible, a thorough coating of thick paint or hot tar); ties and paving blocks (impregnated); posts above stumps and general framing under cover; keels, etc.; would make splendid flooring, but most mills refuse to saw and plane it; a favorite of charcoal burners in Bataan.

Supply.—Rare in Manila market.

Prices.—One hundred pesos to ₱140 per M.

P. laurinum A. Gray TABON-TÁBON.

A tree up to 45 centimeters or more in diameter; reported from: Sib., Sur., Agus., Dav., and Pal. Wood identical with above.

Genus PYGEUM.

A genus of about 18 species, of which only two are widely distributed and well known. As far as known, the character of the wood of all species is the same. The local names of the two species described below seem to be applied to both indifferently.

Local names.—AMUGÁN, amuñgiáng (Bat.); aning-ñgaí (Zam.); apitáng (Cag.); dampól (Bat.); gupil or gupit (Abra, Riz., Lag.); hunúg (Isa.); ipus-ípus (Cebu); kagatúñgan (Riz.); kambál (Riz., Zambo.); kamunog (Cam.); komon (Cag.); LAGO' (Bat., Lag., Tay.); liúsin-gúbat (Bat.); malagmát (Pamp.); pamiliñgan (I. N.); papayu (Bont.); sañgá (Cag., Isa.); tañgá (I. N., Buk.).

Wood moderately hard, moderately heavy; sapwood and heartwood scarcely distinguishable, light reddish brown with occasional widely and irregularly spaced, narrow concentric lines of very porous dark tissue containing glistening red deposits; grain often curly or wavy, and somewhat crossed; texture fairly fine, glossy; seasons well; easy to work. Durability probably III; rarely attacked by beetles.

Structure.—Pith rays moderately thick, distinct; pores medium sized, evenly distributed in small groups and short radial rows, and in abovementioned, narrow concentric lines; soft tissue in small patches about groups of pores; growth rings inconspicuous, marked by a faint, light-colored line.

Uses, supply, and prices.—Used locally for posts, framing, etc.; practically unknown in the Manila trade, but occurs mixed with lots of cheap and medium-grade, miscellaneous lumber, selling at about ₱50 per M.; a very pretty, easily-worked, and substantial wood for cabinetwork.

The following are the best known species of *Pygeum:*

P. glandulosum Merr. AMUGÁN.

A tree up to 40 centimeters in diameter; reported from: I. N., Cag., Isa., Abra, Bont., Beng., Zam., Riz., Lag., Cam., Bat., Min., Neg.

P. preslii Merr. (Plate II, fig. 14.) LÁGO.

A tree up to 60 centimeters in diameter; reported from: Bat., Riz., Lag., Tay., Mar., Ley., Buk., Cota., Zambo., Pal.

LEGUMINOSAE.

[Narra family.]

Next to the lauan family, this is the most important family of timber trees in the Islands, producing a much greater variety of hard, durable, and beautifully colored cabinet woods than any other. The most important and best known are acle (*Albizzia acle*), banuyo (*Wallaceodendron celebicum*), ipil (*Intsia* spp.), narra (*Pterocarpus* spp.), supa (*Sindora supa*), and tindalo (*Pahudia rhomboidea*); another dozen or more species are equally beautiful, but of less importance as being of smaller size or more limited distribution.

The woods of the narra family here described are mostly hard or moderately hard, heavy, or moderately heavy, often very brillantly colored, rarely attacked by beetles. In structure, the chief characteristic of the family is the prominence of the soft tissue, which forms narrow rings or round or elongated patches about the pores, numerous concentric bands, or else netlike and herringbone patterns. The rays are generally fine or very fine; the pores are very variable, both in size and number. In one group, the soft tissue is very inconspicuous; of the woods here described, supa, kayugalu, sibucao and batete belong to this group.

As a general rule the sapwood, especially when very distinct in color from heartwood, is of very poor quality as regards durability, being almost invariably attacked by beetles and very frequently by wood-destroying fungi.

Genus ADENANTHERA.

A. intermedia Merr. TANGLÍN.

A tree up to 70 centimeters in diameter, with a straight and fairly long bole; reported from: I. S., Pang., Zam., Bat., Pamp., Riz., Lag., Tay., Alb., Sor., Sam., Neg., Zambo., Pal.

Local names.—Bagiróro (Alb.); báhai (Zambo.); bugáyong-china (I. S.); butarik (Cag.); ípil or ípil-tanglín (Cag., Zam., Bat.); kinasai-kásai (Blanco's flora); malabágo (Mas.); malasagád (Riz.); maratayúm (N. E.); matáng-uláng (Lag., Tay.); paagáhan (Lag.); pamiásin (Zam.); tadlañgau (Cam.); tañgalín (Lag.); TANGLÍN (Bat., Pamp.); tanglón (Pamp.).

Wood hard; heavy; sapwood 2 to 5 centimeters thick, yellowish or pinkish, rather sharply distinguished from heartwood; heartwood in young trees bright yellow, in large trees light yellowish or reddish brown, turning on exposure to a rich chocolate brown; grain straight or somewhat crossed; texture fairly fine, glossy; general appearance very much like that of ipil (*Intsia* spp.), for which it is sometimes fraudulently or ignorantly substituted, but from which it can be distinguished by the pinkish sapwood, the difference in structure, and the rarity of yellow deposits; seasons well; hard to saw, but not otherwise difficult to work. Durability II; heartwood very rarely attacked by beetles.

Structure.—Pith rays numerous, fine, almost invisible to naked eye; pores medium sized, rather few, evenly scattered; soft tissue in broad rings or elongated patches about pores, often confluent so as to join several or many pores into small groups or irregular wavy lines, or at intervals in belts of denser tissue forming narrow concentric lines which contain fewer and smaller pores than other parts; growth rings, if present, irregular and ill-defined.

Uses.—Posts; beams, joists, rafters, flooring and inside finish; in Pampanga, a favorite for wheels and beds of bull carts; furniture; cabinet-work; would make good ties and paving blocks untreated and excellent ones if treated.

Supply.—Widely distributed, but scarce.

Prices.—Except as an attempted substitute for ipil, rarely marketed.

Genus ALBIZZIA.

A genus containing six timber trees and one climbing shrub (*A. scandens* Merr., reported only from Palawan). All have rather large and very poor white sapwood, and light to dark brown, durable heartwood varying somewhat in structure.

A. acle Merr. (Plate II, fig. 15.) ACLE.

A tree up to 125 centimeters or more in diameter, bole short and often crooked; reported from: I. S., N. E., Pang., Zam., Bat., Pamp., Bul., Riz., Lag., Tay., Cam., Sor., Min., Mas., Tab., Neg., Pal.

Local names.—ACLÉ or aklí (N. E., Un., Pamp., Bat., Bul., Riz., Lag., Tay., Cam., Sor., Min.); anagép (I. S., I. N.); banúyo (Occ. Neg., Tab.); kita-kíta (N. E., Pang., Un., Zam.); lañgin (Mas.); lañgíp (Bis.); sauríri (Pal.); tabalañgí (Bis.); tíli, tílis (Zam.).

Wood hard; moderately heavy to heavy, specific gravity 0.607 (average,

Gardner), 0.610 to 0.693 (Foxworthy); sapwood 2 to 5 centimeters thick, whitish, sharply marked off from heartwood, very perishable; heartwood pale, dull brown to dark walnut brown; coloring matter soluble in water and alcohol; strong peppery odor, dust causing violent sneezing when worked, especially when very dry wood is worked by machinery; when fresh, lathers freely with water or saliva; grain somewhat crossed and often very curly; texture fairly fine, but rough and dull; fairly easy to work. Durability I; practically never attacked by beetles.

Structure.—Pith rays very fine, not numerous, indistinct; pores moderately large, scattered, with a tendency to form irregular wavy lines; soft tissue in conspicuous roundish patches about pores; frequent dirty white deposits in pores; no growth rings.

Uses.—Ties; posts; sills; general construction; all classes of highest grade interior finish, furniture and cabinetwork.

Supply.—Widely distributed, but scarce; there is a fairly steady but small supply in the Manila market.

Prices.—₱160 to ₱250 per M.

A. lebbeck Benth. LAÑGÍL.

A small to medium sized tree cultivated in Luzon, possibly native to Palawan, with wood very similar to acleng-parang.

A. lebbekoides Benth. KARISKÍS.

A small to medium sized tree, up to 40 centimeters in diameter; reported from: I. N., Abra, N. E., Pang., Zam., Bat., Pamp., Riz., Lag., Min., Sib., Cota.

Local names.—KARISKÍS (I. N., Abra, N. E., Zam.); malagánit, malagahánip, malagahánit (N. E., Bat., Riz., Lag.); malasampálok (Bat.); maganhóp sa búkid (Sib.). Wood very similar to acleng-parang.

A. marginata Merr. UNÍK.

A tree up to 60 centimeters in diameter, straight and moderately tall; reported from: I. S., Bont., N. V., N. E., Abra, Bat., Riz., Tay.

Local names.—Kantíñgen (I. S.); kúpang (Bont.); kúpang-babáe, kúpang-bundúk (Bat.); malagahánip (Tay.); malasampálok (Bat., N. E.); malatigí (Riz., Lag.); UNÍK or uníp (Bat., Pamp., Tar.).

Wood light; soft to very soft; sapwood 2 to 4 centimeters thick, whitish, not quite sharply marked off from heartwood; heartwood pale, clear pinkish or reddish brown, with often conspicuous broad growth rings; grain almost perfectly straight; texture fairly fine, homogeneous, smooth, glossy; seasons well; very easy to work. Durability not well known, probably at least III; heartwood rarely attacked by beetles.

Structure.—Pith rays fine, indistinct; pores few, medium sized to large, scattered singly or in small groups; soft tissue forming smooth rings about pores; growth rings 1 to 2 centimeters broad, marked at outer edge by a band, 2 to 3 millimeters broad, of darker, denser tissue.

Uses.—Sheathing and ceiling; bancas; shipping cases for cigarettes; on account of its lightness and even texture would be very good for canoes and light boats.

Supply.—Known only from Luzon; rather scarce.

Prices.—Marketed only with miscellaneous soft lumber at ₱40 to ₱50 per M.

A. procera Benth. ACLENG-PÁRANG.

A tree up to 90 centimeters in diameter, straight, but not tall; reported

from: I. N., Cag., I. S., Beng., Pang., Un., Zam., Bat., Pamp., Bul., Riz., Batg., Min.

Local names.—Adaán (I. N., I. S., Abra, Un., Pang., Beng.); ACLENG-PÁRANG (Bat., Zam., Tar., Pamp., Batg., Min.); alalañgád (Bat., Pamp., Riz.); anaplá (Min.); aninaplá (Tar., Bul., Riz.,); daán (Beng.); kalái (Abra); karaál (Cag., Pang.); karaíl (Zam.); kásai (Or. Neg.); pala-táñgan (I. S.).

Wood hard; moderately heavy to heavy, specific gravity 0.865 (Puigdulles); sapwood 1 to 4 centimeters thick, rather sharply marked off from heartwood; heartwood rich dark chestnut brown, generally with conspicuous irregular darker and lighter bands; grain straight; texture fine, glossy; seasons well; easy to work. Durability at least II; very rarely attacked by beetles.

Structure.—Very similar to acle, without whitish deposits, but with occasional glistening deposits in pores.

Uses.—Posts; poles; ties, sills, beams, joists, rafters; agricultural implements; inside finish; furniture and cabinetwork; carving; recommended for trial for gunstocks.

Supply.—Widely distributed in Luzon and Mindoro, but nowhere abundant.

Prices.—Often sold for acle, but otherwise considerably cheaper.

A. retusa Benth. KÁSAI.

A small to medium sized tree of the beach forests, up to 60 centimeters in diameter; reported from: Bats., Cag., Tay., Cam., Min., Ley., Zambo., Pal.

Local names.—KÁSAI (Cag., Tay., Cam., Min., Pal.); lañgíl (Blanco's flora); malináb (Cag.); saplít (N. Tay.); sintóg (Dav.); tagolo (Cag.).

Wood practically identical with acleng-parang, but somewhat lighter in color.

A. saponaria Bl. SALINGKÚGI.

A tree of the open-forest or parang type, reaching 80 centimeters in diameter; reported from: Bats., I. N., Cag., Isa., Beng., Pang., Zam., Bat., Riz., Pamp., Lag., Tay., Cam., Min., Tic., Sam., Ley., Guim., Bil., Neg., Sur., Agus., Zambo., Bas.

Local names.—Balógo, (Agus.); banaibánai (Cag.); gógo' or gúgo' (Isa., Tay., Agus.); gógo'-kásai (Tay.); gógong-malatokó (Riz.); gógong-tokó (Pang., Bat., Pamp., Cam.); lañgíl (Riz.); malatokó (Bat., Pamp., Riz., Lag.); maratigá, maratekká (I. S.); pipí (Neg.); salanggígí' (Min.); salangkúgi,' SALINGKÚGI', salungkúgi' (Zam., Min., Mas. Tic., Sur., Zambo.); salingkúki' (Bat., Min.); salikúgí' (Sam.); sangginggí' (Agus.); saplít (I. S.); siangkúgi (Sur.); tambing (Beng.); tigían (Guim.); tinagí (Sur.).

Salingkugí seems to have a larger proportion of sapwood and slightly lighter colored heartwood than acleng-parang, but otherwise is scarcely distinguishable from it.

Genus CAESALPINIA.

C. sappan L. (Plate II, fig. 16.) SIBUCÁO.

Known from Northern Luzon to Mindanao as sapáng and sibukáu or SIBUCÁO. A small straggling tree or clambering shrub, reaching 15 to 20 centimeters in diameter, the fine, dense, hard, very heavy, orange-red wood being used chiefly for producing dye (nearly one-half million kilos of wood exported in 1914), but also for treenails, canes, scabbards, small cabinetwork, inlaying, etc. It is practically identical with the Brazil wood, braziletto and pernambuco wood of South America.

Genus CASSIA.

C. javanica L. CAÑA-FÍSTULA.[1]

A tree up to 50 centimeters in diameter; reported from: N. E., Pang., Un., Zam., Bat., Riz., Cav., Batg., Tay., Cam., Sor., Pol., Min., Bur., Ley., Zambo., Bal., Pal.

Local names.—Anchóan or angsóan (Tay., Cam.); apóstola (N. E., Zam., Zambo.); bagiroro (Sor., Bur.,); baláyong (Pang., Min., Pal.); CAÑA-FISTULA (N. E., Un., Pang., Bat., Riz., Lag., Min., Bal.); duláuen (Isa.); dúyong (Cag.); fugáyong (Cag.); kilkíl (Zambo.); malatágum (Cam.); narang-dauél (I. S.); pístula (corruption of Span.); tíndalo (Pang.); tuáling-bakúlau (Zam.).

Wood moderately hard to hard; moderately heavy to heavy, specific gravity 0.679 to 0.897 (Puigdulles); sapwood 2 to 5 centimeters thick, whitish, turning light brown in drying, perishable, rather sharply marked off from heartwood; heartwood bright yellow when fresh, turning yellowish brown to dark brown with age; grain generally distinctly crossed; texture rather coarse in appearance, pores conspicuous on longitudinal section, otherwise dense and taking a smooth surface under a sharp tool; seasons well; fairly easy to work. Durability II; very rarely attacked by beetles.

Structure.—Pith rays fine to very fine, invisible to naked eye; pores medium sized, oval, some with one or two cross partitions; soft tissue very conspicuous, occupying one-third to one-half of total area, in large rounded patches about pores, the patches often confluent so as to form long, wavy, tangential lines, which toward the end of each growth ring tend to become narrower, more continuous and more nearly parallel; growth rings sometimes marked as described, sometimes very indistinct or absent.

Uses.—Posts; ties; beams, joists, rafters; flooring; interior finish; dugout canoes; furniture; cabinetwork.

Supply.—Widely distributed, but scarce; rarely seen in Manila market, but well and favorably known wherever it occurs.

Several other species of *Cassia* are known, but are all either introduced cultivated trees or, if native, small and of very limited distribution. It is not probable that any of these are cut for lumber.

Genus ERYTHROPHLOEUM.

E. densiflorum Merr. KAMÁTOG.

A tree up to 95 centimeters in diameter, straight, but not tall; reported from: Cag., Riz., Tay., Lan., Zambo.

Local names.—Abbíhal (Cag.); bátik (Tay.); kadír (I. N.); kalamátau, KAMÁTOG (Tay.); n̄girik-n̄gírik or n̄girikn̄gík (Cag.); pali (Lan.); salsál (Cag.); taklóban (Tay.).

Wood moderately hard; moderately heavy; sapwood 2 to 6 centimeters thick, whitish, turning pale reddish brown in drying, sometimes quite sharply distinguished, sometimes merging very gradually into heartwood, perishable; heartwood bright red, becoming somewhat dull with age; grain distinctly crossed in broad bands; texture rather coarse; in color and grain resembling tindalo, but of somewhat softer, coarser texture; does not check much, but is liable to warp if not carefully seasoned; easy to work. Durability III; heartwood rarely attacked by beetles.

Structure.—Pith rays very fine, numerous; pores numerous, small to

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[1] The Spanish popular name of *C. fistula* L., an Indian species introduced and cultivated in the Islands. From the similarity of the trees, and especially the fruits, this name (or corrupted forms of it) has become by far the most widely known name for the native tree.

medium, evenly scattered; soft tissue very similar to but not quite as conspicuous as in caña-fistula; growth rings similar to caña-fistula, but even less regularly and distinctly marked.

Uses.—Posts above stumps; beams, joists, rafters; floors; sheathing and ceiling; furniture and cabinetwork.

Supply.—Widely distributed, but scarce.

Prices.—Ninety pesos to ₱125.00 per M.

Genus GLIRICIDIA.

G. sepium Steud. MADRE-CACÁO.

A small tree introduced from America in the eighteenth century as a shade tree for cacao plantations, now very widely distributed as an ornamental, and to some extent naturalized, everywhere known either as MADRE-CACAO (Span.), or kakauáti (cacauáti, Mex.-Span.). It never grows to saw timber size, but the dense, fine, hard and heavy, yellowish to dark brown, durable wood is used locally for small house posts and other structural parts, agricultural implements, treenails, tool handles, etc.

Structure.—Pith rays fine, numerous; pores small, numerous, choked with dark, spongy, often glistening soft tissue; lighter colored soft tissue in ragged patches about pores, sometimes connecting several pores in tangential lines, and forming 2, 3 or more fairly continuous, roughly parallel concentric lines at the end of each growth ring; occasional sulphur-yellow deposits in soft tissue about pores.

Genus INTSIA.

I. acuminata Merr.

A tree 60 centimeters or more in diameter, reported from: Cag., Tay., Din.

Local names.—Balahían (Cag.); bayugbúg (Din.); IPIL (Tay.); tíndalo (Tay.). Wood identical with following species.

I. bijuga O. Ktze. (Plate III, fig. 17.) ÍPIL.

A tall straight tree, up to 180 centimeters in diameter; reported from: Bats., Cag., Zam., Bat., Tay., Cam., Sor., Min., Mas., Tic., Sam., Ley., Cap., Guim., Cebu, Neg., Sib., Sur., Mis., Lan., Cota., Zambo., Bas., Pal.

Local name.—Universally known as ÍPIL, a name very rarely applied to species of any other genus.

Wood hard to very hard; heavy to very heavy, specific gravity 0.673 to 0.807 (Gardner), 0.758 to 0.909 (Foxworthy); sapwood 4 to 8 centimeters thick, whitish, sharply distinguished from heartwood, very perishable; heartwood when fresh and perfectly sound bright yellow, turning to dark brown on exposure; peculiar, oily odor resembling that of raw peanuts; small quantities of oil exuding from surface, causing characteristic, small, dull black spots when sandpapered; when fresh, oil makes indelible brown spots on paper and cloth; grain straight or somewhat crossed; texture fine, taking a glossy cut under sharp tools; does not warp much, but in large sizes is liable to check badly if not seasoned carefully; hard to saw, but not difficult to surface. Durability I, except as regards teredo.

Structure.—Pith rays fine; pores small, scattered; soft tissue in elongated patches about pores, sometimes connecting several pores in short tangential or diagonal lines; sulphur-yellow deposits in pores or in soft tissue about them; growth rings sometimes irregular and indistinct, sometimes rather sharply defined by a very thin light line.

Uses.—All high-class general construction; posts; beams, joints, raf-

ters; electric poles; sills; ties; paving blocks; flooring, siding, sheathing; doors and windows; ship, wharf, and bridge building (except salt-water piling); furniture and cabinetwork; hubs, spokes, tongues and cart beds; necks and heads of musical instruments; tool handles; harrow teeth and other parts of agricultural implements; altogether, on account of its hardness, stiffness, and great durability, one of the best woods in the Islands.

Supply.—Found in practically all provinces having a seacoast; though not as abundant as any of the dipterocarps, there is a steady supply of it in the markets. *Intsia acuminata* is much scarcer than *I. bijuga* and there is no doubt that at least 95 per cent of ipil in the markets is from the latter species.

Prices.—One hundred and fifty pesos to ₱200 per M.

Genus KINGIODENDRON.

K. alternifolium Merr. (Pl. III, Fig. 18.) BATÉTE.

A tall straight tree, up to 100 centimeters or more in diameter; reported from: Cag., Tay., Cam., Alb., Sor., Mas., Tic., Tab., Sam., Ley., Neg., Mis., Agus., Cota., Zambo., Samal.

Local names.—Bagbalógo (Sam.); báhai (Bat., Zambo.); BATÉTE (Tay., Sor., Mas., Tic.); bitañgól (Agus.); danggái (Tay., Cam., Alb., Sor., Mas.); duká (Tab., Ley., Occ., Neg.); mabalógo (Sam.); palomaria (Zambo.); painá', payiná', paliná', pariná', (Cam., Alb., Sor., Sam., Dav.); salaláñgin (Alb., Sor.); tuáan (Mis.).

Wood soft to moderately hard; moderately heavy; sapwood 1.5 to 5 centimeters thick, pale red turning to dull brown in drying, not quite sharply distinguished from heartwood; heartwood light to dark reddish brown, with blackish streaks due to the oil which stains all surfaces; grain fairly straight; texture fine, smooth but not glossy; chips color water purplish brown; checks very little, but warps badly if not carefully seasoned; fairly easy to work. Durability III; heartwood rarely attacked by insects other than termites, which destroy it rapidly.

Structure.—Pith rays fine, indistinct; pores few, medium sized, scattered; soft tissue inconspicuous, in small patches about pores, and in thin, continuous, but irregularly spaced concentric lines; growth rings indistinct.

Uses.—Posts above stumps; beams, joists, rafters; flooring; doors; sheathing and other interior finish; furniture; paving blocks and ties (treated).

Supply.—Found from central Luzon to Mindanao; large trees fairly numerous in portions of Masbate, elsewhere scattered. Rare in Manila market.

Prices.—One hundred pesos to ₱125 per M.

Genus KOOMPASSIA.

K. excelsa Taub. MANGGÍS

A tall straight tree, up to 100 centimeters or more in diameter. Known so far only from Palawan, with local name MANGGÍS. Known in Borneo as tapang, kayu rajah, and mangaris.

Wood hard; brittle; heavy; sapwood whitish, sharply distinguished from heartwood; heartwood rich reddish brown, often with conspicuous broad lighter and darker belts; at very irregular intervals occur belts 1 to 2 centimeters broad, containing no larger pores at all; easy to work. Durability unknown, but probably at least III.

Structure.—Pith rays fine, numerous, distinct, but in nonporous belts becoming thicker, crinkled, and indistinct; pores medium to large, often partitioned, tending to form radial lines of 3 to 6 pores; soft tissue conspicuous, in numerous wavy, continuous, sometimes branching but roughly parallel concentric lines generally connecting the pores; growth rings very indistinct or absent; very large and conspicuous ripple marks on all longitudinal sections.

Uses.—No uses known, but would make a beautiful interior finish, furniture, and cabinetwood.

Supply.—Large trees fairly numerous in parts of Palawan.

Prices.—Unknown in Manila market, but should be worth ₱150 per M.

Genus ORMOSIA.

O. calavensis Azaola — BÁHAI.

A tree up to 60 centimeters in diameter, straight but not tall; reported from: Cag., I. S., Bat., Riz., Lag., Batg., Tay., Cam., Mas., Ley., Neg., Sur., Agus., Zambo., Bas.

Local names.—Amúyong (Bat.); BÁHAI (Bat., Lag., Tay., Cam.); bugáyong (I. S., Cag.); tandang-isók (Mas.); commercial material from Palawan, with local name bayóto, seems to be of this species.

Wood hard; moderately heavy; sapwood very large, whitish; heartwood bright orange red, darkening somewhat with age; grain frequently wavy and curly; texture rather coarse in appearance, but dense and glossy; general appearance very much like tindalo; seasons well; fairly easy to work. Durability III, heartwood not attacked by beetles.

Structure.—Pith rays fine to medium, distinct; pores small to medium, evenly scattered; soft tissue very conspicuous, in large roundish patches about pores, generally connecting a number of pores in wavy, branching, tangential or diagonal patterns like a "mackerel sky;" growth rings indistinct or absent.

Uses.—House posts; beams, joists, rafters; interior finish; furniture and cabinetwork.

Supply.—Known only from Luzon and Masbate; scarce.

Prices.—Sometimes ignorantly or intentionally substituted for tindalo, but otherwise much lower in price, and probably, when sawn, most generally mixed with miscellaneous lumber.

O. paniculata Merr.

Has been reported only from Bataan; the wood is unknown, but it is possible that báhai from this province is of this species. *O. villamilii* Merr. is reported from Cam. and Zambo., wood scarcely known.

Genus PAHUDIA.

P. rhomboidea Prain. (Pl. III, fig. 19.) — TINDALO.

A tree up to 120 centimeters in diameter, straight but not tall; reported from: I. N., Cag., Palaui, Isa., Pang., Zam., Bat., Bul., Riz., Lag., Cam., Sor., Pol., Min., Ambil, Mas., Mar., Tic., Ley., Sib., Cebu, Sur., Agus., Cota., Zambo., Pal.

Local names.—Apálit (Pang.); bagalayáu, magalayáu (Cag., Isa.); balahiáu (Palaui); baláyung (Riz., Lag., Pol., Cebu, Neg., Min., Mar.); baráyung (Cam., Sor., Mas., Tic., Cat., Ley.); bayádgung (Sur.); báyung (Cebu, Agus., Sur.); biálung or biárung (Agus., Cota.); ipil (I. N., Cag., Isa.); sañgái (Cam.); TÍNDALÓ (Zam., Bat., Bul., Riz., Tay., Min., Mar.).

Wood hard; heavy, specific gravity 0.772 to 0.805 (Gardner), 0.878 (Foxworthy); sapwood 2 to 4 centimeters thick, white, perishable, sharply distinguished from heartwood; heartwood saffron or pale orange, turning with age to a deep, rich red, sometimes with irregular blackish streaks; grain straight or slightly crossed, sometimes with scattered bird's-eye knots; odor resembling that of raw beans or peanuts, not as pronounced as in ipil; texture fine, dense, and smooth, taking a glossy cut under sharp tools; seasons well, being perhaps less subject to checking and warping than any other well-known Philippine cabinet wood; saws smoothly and is not difficult to shape and surface. Durability II; rarely attacked even by termites, but not very durable in ground or exposed to teredo.

Structure.—Pith rays fine, distinct; pores small to medium sized, scattered but with some tendency to form tangential or diagonal lines; soft tissue very conspicuous in elongated patches about pores, often confluent into interrupted tangential or diagonal lines, and in numerous, thin, irregularly spaced, continuous concentric lines containing few or no pores; in heart of young, rapid-growing trees, these lines clearly mark the end of the growth rings, in later wood they are often so closely but irregularly spaced that the growth rings are entirely obscured; occasional whitish deposits in pores and soft tissue.

Uses.—One of the finest, if not the finest, of Philippine cabinet woods; all kinds of high-grade construction (except posts set in ground); interior finish; floors; doors; windows; window sills; a favorite for stair treads and hand rails on account of its indestructible color and its hardness; musical instruments; tool handles, saw frames, etc.

Supply.—Very widely distributed, but not as abundant as ipil and narra; always small quantities on hand in Manila.

Prices.—One hundred and seventy pesos to ₱240 per M.

Genus PARKIA.

P. sherfeseei Merr. KUNDÍNG.

Reported so far only from Agusan; wood identical with following.

P. timoriana Merr. (Plate III, fig. 20.) CÚPANG.

A tall, straight tree, up to 180 centimeters in diameter; reported from: Beng., Zam., Bat., Riz., Lag., Tay., Pal.

Local names.—Bagin (Beng.); CÚPANG (N. E., Pamp., Tar., Zam., Bat., Lag., Tay., Pal.).

Wood soft; light, specific gravity 0.285 (Foxworthy), 0.317 to 0.422 (Gardner); sapwood very large (up to 25 centimeters or more), whitish, bluing very easily unless quickly and thoroughly seasoned, sharply marked off from heartwood; heartwood pale brown, with broad slightly lighter and darker belts; grain straight or slightly crossed; texture rather coarse in appearance, but taking a smooth finish under sharp tools; strong disgusting odor while drying, which, however, disappears completely; aside from bluing, seasons well; very easy to work. Durability IV, but rarely attacked by beetles.

Structure.—Pith rays fine, but distinct; pores small to medium, moderately numerous, very evenly scattered; soft tissue in rounded patches about pores, not commonly connected in rows; growth rings marked by a very faint, narrow line.

Uses.—Light and temporary construction; cheap siding; boxes; wooden shoes; wooden washbowls and other household and kitchen utensils. Wood burns slowly and completely, holding fire very well.

Supply and prices.—Rarely or never marketed alone, but mixed with cheap miscellaneous lumber.

Genus PTEROCARPUS.

P. blancoi Merr. BLANCO'S NÁRRA.

Reported from: N. E., Bul., Riz., Cam., Sor., Min., Mas., Tic.

P. echinatus Pers. PRICKLY NÁRRA.

Reported from: I. N., Cag., I. S., Isa., Bul., Lag., Tay., Cam., Sor., Min., Sib., Cebu, Cota.

P. indicus Willd. (Pl. III, fig. 21.) NÁRRA.

Reported from: Cag., Pang., Cam., Min., Mas., Rom., Tab., Ley., Neg., Sur., Agus., Mis., Lan., Cota., Zambo.

Specimens of *Pterocarpus* not specifically determined are also reported from the following additional islands or provinces: Abra, Beng., Un., Mar., Sam., Cap., Bal., Pal.

Trees up to 200 centimeters in diameter, generally short and often crooked.

Local names.—As the three species are indistinguishable except by botanical characters, the local names are given regardless of specific distinctions. The official and commercial name is the Spanish NARRA, from Tagalog nára (N. & C. Luzon, Min., Mas.); nága (S. Luzon, Bisaya Islands, Pal.); nála (Mindanao and adjacent islands); other names are: antagán (Isa.); apálit (Tar., Pamp.); asaná' (N. E., Tar., Bul., Bat., Riz., Lag., Tay.); bitalí or vitalí (Zambo.); dúñgon (I. N., Cag.); hagad (Cag.) kamárag (Abra); odiáu (Pang).; sagát, taggá', taggat, tagká' (Cag.). *P. indicus* and other species of this genus furnish some of the true rosewoods of India and Burma.

Wood moderately hard to hard; moderately heavy, specific gravity 0.580 (Foxworthy), 0.540 to 0.563 (Gardner); sapwood 2 to 8 centimeters thick, whitish, perishable, sharply distinguished from heartwood; heartwood the most variable in color of all well-known Philippine woods, ranging from pale straw color through all possible shades of pink, salmon, and red to deep blood red and occasionally dull brown without any red tint; as far as known, all species may produce wood of any color, the commercial classification of "red", "yellow" and "white narra" being applicable only after the tree is felled and sawn; frequently large logs have a more or less thick brilliant red belt just inside the sapwood, shading off toward the heart into light red, brown, or yellow; the yellow and pale-red varieties hold their color well, the dark red almost invariably changes in time, even under good varnish, to a deep, dull reddish brown; grain somewhat crossed, frequently very curly or wavy; texture rather fine, but pores conspicuous on all longitudinal sections; fine, uniform ripple marks on tangential sections (these are often more conspicuous on a split than on a planed surface, and, as a rule clearer to the naked eye than under the lens); next to the structure in cross section, the ripple marks are the surest means of distinguishing between narra and tindalo, which never has them; faint, sweet cedar or camphor-like odor; chips color water red, changing in shallow layers to iridescent blue-green; seasons well, shrinking and checking little and warping hardly at all; easy to work. Durability II; very rarely attacked even by termites.

Structure.—Pith rays very fine; ring porous, inner part of ring occupied by an irregular narrow row of large pores, a few large pores

with smaller ones scattered through outer part of ring; many pores with glistening deposits; soft tissue in numerous, fine, often interrupted, wavy but roughly parallel tangential lines; growth rings generally distinct, but sometimes with pores so scattered and lines of soft tissue so crowded as to obscure the rings.

Uses.—By far the most widely known high-grade interior finish, furniture, and cabinet wood of the Philippines, and put to every conceivable use in this line; also household implements, tool handles, saw frames, try-squares, yard and meter sticks, rulers, etc.; dry measures; musical instruments; carriage and automobile panels and dashboards; plain and carved jewel and clothes chests; canes; scabbards; carved picture frames; occasionally found in mixed lots of railway ties; a great majority of the single-piece round table tops are made from the buttress roots of narra.

Supply.—Though not abundant, the supply in the Manila market is steadier than that of any other cabinet wood.

Sizes.—Diameter commonly up to 70 or 80 centimeters, exceptional logs up to 150 or 200 centimeters.

Prices.—Two hundred pesos per M. for lighter colored and softer varieties up to ₱350 for prime red.

Genus SINDORA.

S. inermis Merr. KAYU-GÁLU.

This species has been reported only from Cotabato and Davao. The wood is very similar to that of supa, but has a very pleasant aromatic odor when fresh. The sapwood is very much larger than in supa, being 15 centimeters thick in one specimen of 45 centimeters diameter.

S. supa Merr. (Pl. III, fig. 22.) SUPÁ.

A straight, moderately tall tree, up to 180 centimeters in diameter; reported from: N. E., Tay., Cam., Alb., Min.

Local names.—Baláyung (Tay.); manapo (N. Tay.); painá', payiná,' or pariná' (Cam., Alb., Sor.); SUPÁ (Tay., Cam., Alb., Min.).

Wood hard; heavy, specific gravity 0.729 (Foxworthy), 0.711 to 0.813 (Gardner); sapwood 4 to 5 centimeters thick, pinkish, sharply marked off from heartwood, not so soft and perishable as in acle, narra, tindalo, etc.; heartwood yellow or pinkish when fresh, gradually turning dark-bronze color with age; grain somewhat crossed, forming a narow ribbon when quarter sawn, rarely curly or wavy; texture very fine, dense and smooth; faint peppery odor; chips color water reddish brown; seasons slowly, but with very little checking or warping; rather difficult to work. Durability II; very rarely attacked by beetles.

Structure.—Pith rays fine, but distinct; pores small to medium sized, exuding small quantities of oil on transverse sections, sometimes a very little also on longitudinal sections; soft tissue inconspicuous, forming very thin rings about pores and a fine, but distinct line at the end of each growth ring; growth rings generally somewhat lighter and more porous in inner, and darker and denser in outer part, but often marked only by the line of soft tissue.

Uses.—Formerly used in general construction for beams, joists, rafters, etc., and in bridge, wharf and shipbuilding, but now too highly valued for interior finish, furniture and cabinetwork, and especially flooring, to be put to the former uses; also an excellent wood for fine turned and shaped tool handles, rulers, and other desk supplies.

Supply.—Practically the only supply in the Manila market comes from

southern Tayabas and Camarines. The supply is small, but fairly steady in small dimensions.

Prices.—One hundred and twenty pesos per M.

Genus TAMARINDUS.

T. indica L. SAMPÁLOK.

Local names.—Kalamági, salamági and similar forms (N. Luz. and Bis.); sambág, sambák (S. Luz. and Bis.); SAMPÁLOK (C. Luz.); the tamarind tree.

Wood hard; heavy, tough and difficult to split; sapwood very large (25 centimeters or more), whitish; heartwood small and irregular, purplish brown; grain crossed in narrow belts; texture fine, dense, smooth; seasons fairly well; difficult to work. Durability of sapwood III, blues easily in seasoning, but not attacked by beetles; heartwood said to be very durable (Gamble).

Structure.—Pith rays fine, numerous, distinct; pores numerous, small, evenly scattered; soft tissue in roundish or elongated patches about pores; growth rings marked by a fine line of soft tissue.

A large tree introduced into the Philippines in prehistoric times and common about towns and settlements; there are two trees in the Tondo district of Manila 120 to 130 centimeters in diameter and 30 to 35 meters high. The wood never comes into the market, but is occasionally used locally for household and agricultural implements, small pieces of furniture, wooden tools, tool handles, etc.

Genus WALLACEODENDRON.

W. celebicum Koord. (Pl. III, fig.23.) BANÚYO.

A tree up to 150 centimeters in diameter, bole short and often crooked; reported from: Bab., Cag., Isa., N. E., Cam., Tay., Mas., Tic., Bur., Sam., Neg.

Local names.—Baláyung (Neg.); BANÚYO (Tay., Cam., Sor., Mas., Tic., Bur., Sam., Neg.); dauél, dauér (Cag.); lupigí (Bab., Cag.); kúpang-bundúk (N. Tay.); melmél, melmér (Cag.); magdau (Neg.); malatágum (N. E.); narang-dauél (Cag.); supéñgun (Isa.). Small quantities have been sold in the United States as "Derham mahogany."

Wood moderately hard; moderately heavy, specific gravity 0.525 (Gardner); sapwood 1 to 3 centimeters thick, whitish, generally sharply distinguished from heartwood; heartwood light golden brown to dark coffee color, sometimes with distinct reddish tint; grain as a rule straight or slightly crossed, sometimes curly or wavy; texture rather fine, glossy; seasons very well; easy to work. Durability III; heartwood very rarely attacked by beetles.

Structure.—Pith rays fine and indistinct; pores few, rather small, evenly scattered; soft tissue in small rounded patches about pores, sometimes confluent in small groups, and in a thin light-colored line at end of each growth ring; growth rings generally quite distinct, but sometimes only marked by line of soft tisue.

Uses.—All sorts of interior finish; doors; windows; shell screens; furniture and cabinetwork; carriage panels; carved picture frames; musical instruments; ship cabins.

Supply.—Very widely distributed, but in many regions scarce and apparently not well known; the supply in the Manila market is rather small, but steady, coming principally from Southern Luzon and Masbate.

Prices.—One hundred and forty pesos to ₱210 per M.

LINACEAE.

[Sudiang family.]

A family represented in the Philippines by a single tree, sudiang.

Genus CTENOLOPHON.

C. philippinensis Hall. f. SUDIÁNG.

A moderately tall straight tree up to 75 centimeters or more in diameter.

Reported only from Surigao and Samar, always with same name.

Wood hard to very hard; heavy to very heavy; sapwood about 3 centimeters thick, pinkish brown; heartwood somewhat darker, with irregular, dark-brown or almost black mottlings and streaks; contains much sticky oil or resin and burns with a very smoky flame and resinous odor; grain straight; texture fine, dense, but rough; seems to season well; difficult to work. Durability said in Surigao to be I.

Structure.—Pith rays fine, fairly distinct in sapwood, but very indistinct in heartwood, being soaked with oil and so darkened to the color of surrounding tissue; pores small, uniform in size, very evenly scattered; soft tissue inconspicuous, in numerous, minute, wavy and broken tangential lines often connecting several pores; in heartwood obscured, like pith rays, by being soaked with oil; growth rings sometimes faintly indicated in sapwood by an ill-defined, narrow band of somewhat dense tissue.

Uses.—Piles; poles; posts, beams, joists, rafters; bridge, wharf and ship building; paving blocks; window sills; tool handles; agricultural implements; floors; doors; windows; canes; treenails; furniture and cabinet-work.

Supply.—Reported as scarce in Samar, well known but not abundant in Surigao; never brought to Manila market.

Prices.—Has no regular market price, but for high-grade construction, ties, flooring, etc., should be worth as much as ipil.

RUTACEAE.

[Kamuning family.]

A family containing, beside the oranges and lemons (*Citrus* spp.), only one well-known tree, kamuning.

Genus MURRAYA.

M. exotica L. (Pl. III, fig. 24.) KAMÚNING.

A small tree, up to 25 centimeters in diameter, with a short and generally very irregular bole; reported from: Bab., Bats., I. N., Cag., Isa., N. E., Pang., Zam., Bat., Pamp., Riz., Man., Batg., Tay., Cam., Min., Mas., Sam., Ley., Neg., Cota., Zambo, Pal.; probably found also in many other regions.

Local names.—Everywhere known as banási, banaási, banáti, or KAMÚNING.

Wood very hard; very heavy; sapwood 1 to 4 centimeters thick, light yellow, rather sharply marked off from heartwood; heartwood brown, with irregular lighter and darker streaks; grain straight or slightly crossed; texture extremely fine and dense, glossy; sapwood very similar to boxwood, and heartwood reminding one of olivewood; seasons very slowly and with but little warping and splitting. Durability at least II; rarely if ever attacked by beetles.

Structure.—Pith rays very fine; pores very small; soft tissue forming numerous very fine but distinct concentric lines, often branching and running together again; growth rings irregular, ill defined.

Uses.—Tool handles; turned and carved articles; paper weights, paper knives, and other desk supplies; canes; wood type and woodcuts; inlaying; flutes and billiard cues (Puigdulles); a prime favorite for fine bolo hilts.

Supply.—Very limited.

Prices.—On account of its small size and scarcity, kamuning is not regularly cut for any industry, and no sales are recorded.

BURSERACEAE.

[Pili family.]

A family containing no tree of great importance in the lumber trade, but one genus, *Canarium,* that is found and is well known in practically every island and province and to which belongs the pili, and another genus, *Garuga,* that produces bogo, a very pretty, though rare, cabinet wood.

Genus CANARIUM.

A genus represented in the Philippines by more than 45 species, one or more of which are probably found in every province.

C. luzonicum A. Gray. (Pl. IV, fig. 25.[1]) PÍLI.

A medium-sized tree, up to 60 centimeters in diameter; reported from: Cag., I. S., Isa., Abra, Pang., Bat., Riz., Lag., Tay., Cam., Alb., Sor., Min., Mas., Mar., Tic.

Local names.—Antáng, anténg (Cag., Isa.); bakán (Abra); bakóog (I. S.); belis (Tay.); buláu (Pang.); piláuai or piláui (Tay.); PÍLI (N. E., Tar., Bat., Riz., Lag., Tay., Cam., Alb., Sor., Min., Mas., Tic.); pagsahiñgin, sáhing, and similar forms (Bat.).

In regions where pili nuts are large, abundant, and of good quality, forming a well-known food product, the tree is almost invariably known as pili; where the nuts are of poor quality or scarce, the tree is confused with the numerous other species of the genus.

This same species also produces pili resin, the "Manila elemi" of commerce, used locally in medicine, for incense, and for calking, and exported to Europe in considerable quantities for the extraction of medicinal substances.

Wood moderately hard; moderately heavy; sapwood small (2 to 3 centimeters) whitish, turning gray in drying, not sharply marked off from heartwood; heartwood pale reddish brown; grain straight; texture fine, dense, glossy; seasons well, but is subject to attacks of "shothole beetles"; rather easy to work. Durability IV.

Structure.—Pith rays moderately broad, distinct, not numerous, sometimes with scanty whitish deposits; pores small to medium, evenly scattered; soft tissue inconspicuous; growth rings inconspicuous, sometimes marked by a thin band of darker tissue.

Uses.—Ties and paving blocks (treated); house posts (said to last 10 to 15 years, if portion in ground is charred); cheap construction; furniture; box lumber.

Supply.—Limited.

Prices.—Marketed only occasionally with miscellaneous lumber.

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[1] This figure is from a specimen without specific determination; the structure of all species of the genus is practically identical.

C. villosum F.-Vill. PAGSAHÍÑGIN.

This is probably both the largest and most widely distributed species of the genus; a tree up to 100 centimeters or over in diameter; reported from: Cag., I. N., I. S., Isa., Abra, Bont., Beng., N. V., Un., Pang., Zam., Bat., Riz., Lag., Batg., Tay., Min., Mas., Mar., Cebu, Neg., Zambo., Pal.

Local names.—Anánggi (Tay., Cam.); anténg (Cag., I. S., Pang., Un., Zam.); bréa (Zambo.); dulit (Pang., Zam.); girét (Negrito, Cag.); milipíli (Cebu); pagsáhing (Batg.); PAGSAHÍÑGIN (Bat.); palsaíñgin (Mar.); patsaíñgin (Zam., Riz., Lag.); písa (Abra); sáhing (Pal.); saong-saóñgan (Cebu); sanaí (Neg.); sulusalúñgan (Neg.). Most or all of these names are also frequently given for other species of the genus.

The wood of this and all other species, as far as known, is very similar to pili, except that some seem to have commonly a rather darker brown heartwood. It is rarely marketed alone, coming to Manila only in mixed lots of medium-grade miscellaneous lumber, mostly as small dimension stuff, such as for studding, joists, and rafters, selling for ₱40 to ₱50 per M.; has also been cut for cheap railway ties.

Genus GARUGA.

A genus of three or four species of small to medium-sized trees producing a very pretty red wood. The local names seem to be applied indifferently to all and are here given for the entire genus without regard to species.

Local names.—Abílo' or gabilo' (Tag.); amúgis (N. E., Riz.): bagulibás (Min.); barrús (Cag.); bió (I. S., Pang.); BÓGO, búgo, or búgu (Tay., Batg., Mas., Occ. Neg., Cebu, Mis., Cota., Zambo., Sulu, Pal.); libás (Tay.); ligáson (Batg., Tay.); taliñgánan (Zambo.); tumbaríla (Pal.).

G. abilo Merr. BÓGO.

A tree up to 100 centimeters in diameter, with a straight but not very long bole; reported from: Cag., I. S., N. E., Pang., Riz., Batg., Tay., Occ. Neg., Dav., Zambo.

Wood moderately hard; heavy; sapwood large (4 to 8 centimeters), whitish, staining to dirty gray in drying, rather sharply marked off from heartwood; heartwood coppery red, sometimes with blackish streaks; when not streaky, looks exactly like amugis (*Koordersiodendron pinnatum*); grain generally straight; texture rather fine, smooth; easy to work. Durability of heartwood probably fair, sapwood much subject to attack by beetles.

Structure.—Pith rays moderately broad, irregular in thickness and spacing, often bending very noticeably around the pores; pores large, scattered, often partitioned, sometimes with dark, shiny deposits; soft tissue hardly noticeable.

Uses.—Interior finish; furniture and cabinetwork.

Supply.—Limited.

Prices.—Not known in Manila market.

G. clarkii Merr.

A tree up to 80 centimeters in diameter; reported from: Mas., Pal.; wood practically identical with above.

G. littoralis Merr.

A tree up to 70 centimeters in diameter; reported from: Min., Mas., Neg., Cota., Sulu, Pal.; wood practically identical with above.

Genus SANTIRIA.

A genus of about five species, of which only one seems to be rather widely distributed, the others having been reported only from one or two localities each.

S. nitida Merr. KAMÍÑGI.

A medium-sized tree, up to 60 centimeters in diameter, straight and moderately tall; reported from: Bat., Lag., Tay., Min., Sib., Neg.

Local names.—Alupág-machíng (Bat.); bógo, gatásan (Occ. Neg.); KAMÍÑGI, kórig (Bat.); lahi-láhi (Sur.); óris ñga púrau (I. N.); sambuluán (Occ. Neg.); sáyong (Cap.).

Wood hard; heavy; sapwood small (2 to 3 centimeters), brownish white, not sharply marked off from heartwood; heartwood pale reddish brown; grain straight; texture fine, smooth; very similar in all respects to pili, but tougher and more difficult to work. Durability III, sapwood often attacked by beetles.

Structure.—Pith rays fine to medium, numerous, indistinct; pores small, numerous, evenly scattered; soft tissue inconspicuous; growth rings, if present, very indistinct.

Uses.—Ordinary construction; cheap furniture; ties and paving blocks (treated).

Supply.—Limited.

Prices.—Rarely if ever marketed except with medium-grade miscellaneous lumber, selling at ₱50 to ₱60 per M.

MELIACEAE.

[Calantas family.]

A family containing a considerable number of timber trees, most of them neither very large nor abundant, but many of excellent quality and of beautiful coloring. The largest and most widely known tree of the family in the Philippines is calantas (*Toona calantas*), practically identical with both the Indian "toon" and the "Spanish cedar" or "cigar-box wood". The woods have a very wide range of color and hardness, yellowish white, yellow, and various shades of red being commonest. A large part of all the species of the family have very characteristic aromatic odors.

Genus AGLAIA.

A genus of about 50 species in the Philippines, many of them very widely distributed, but none reaching large size. Except for rather wide variation in hardness and depth of color, the woods of the larger trees of the genus are very uniform in appearance and structure, so that a general description of the genus will give the principal characters of any species.

Wood hard to very hard; heavy to very heavy; sapwood pinkish or pale red, clearly but not sharply distinguished from heartwood; heartwood pale red to deep coppery red; grain often distinctly crossed and generally wavy, forming a regular diagonal wavy ribbon on radial sections; on tangential sections, an irregular, curly figure, marked with characteristic fine zigzag lines formed by cutting through wavy concentric belts of soft tissue; texture fine, dense, taking a very smooth surface under sharp tools; seasons well; most species with a distinct, even pungent, aromatic odor resembling both cedar and camphor; the odor seems to be strongest and most lasting in tucang-calao (*Aglaia clarkii*); small drops of clear resin sometimes exude

from fresh specimens of this and other species; rather difficult to work, the curly and wavy grain requiring a very sharp and fine-set plane to surface it well. Durability at least II; heartwood rarely if ever attacked by termites, nor even sapwood by beetles.

Structure.—Pith rays fine or very fine, but distinct; pores small to medium, scattered, often choked with light colored tyloses; soft tissue in narrow rings or very small irregular patches about pores and forming numerous (about five to the millimeter of radius), wavy, broken, branching and confluent, but roughly parallel concentric lines; growth rings absent or, if present, very irregular in width and distinctness.

Uses.—There are few records of uses of the majority of the species of *Aglaia*, as they rarely come into the market except in occasional very small lots; they are well known locally in most regions for their strength and durability, being favorites for house posts, beams, window sills, windows, agricultural implements, etc. The only species well known commercially is tucang-calao; there is no doubt that, for beauty, strength and durability, the wood of most of the other species, when from sufficiently large trees, is equal to it. For tucang-calao the following uses are known: posts; ties; bridge and wharf building; beams, joists, rafters; flooring; sheathing and ceiling; fine furniture and cabinetwork; would make beautiful, strong, durable, and probably entirely moth-proof chests.

The following species reach at least 30 centimeters in diameter and the character of their woods is known from authentic specimens.

A. badia Merr.

A tree up to 50 centimeters in diameter; reported only from Cagayan; wood hard, heavy, dark red; odor not strong.

A. bicolor Merr. BATUKANÁG.

A tree up to 100 centimeters in diameter; reported from: I. S., Pang., Riz., Cota., Bas.

Local names.—Bakaláu (Pang.); basinau (Cota.); BATUKANÁG (I. S.); salamíñgai (Riz.).

Wood very hard and dense, very heavy; dark coppery red; equal to tucang-calao in beauty, hardness, strength, and durability.

A. clarkii Merr. (Pl. IV, fig. 26.) TUCÁNG-CÁLAO.

A tree up to 85 centimeters in diameter; reported from: I. S., to Alb., Mas., Tab., Cebu.

Local names.—Alámag (Alb.); balúi (Pang.); batukanág (I. S.); kansúlud (Alb.); kansúyud (Tab.); makópa or makópanggúbat (Cav., Batg.); saldaná (Cebu); TUCÁNG-CÁLAO (Tay., Cam., Alb., Mas.).

The best-known commercial wood of the genus; bright coppery red, with beautiful diagonal, wavy, ribbon grain in radial section; odor very pronounced.

Supply.—Limited; comes into Manila market occasionally in small lots from S. Luz. and Mas.

Prices.—One hundred and twenty pesos to ₱150 per M.

A. diffusa Merr. MALASÁGING.

A tree up to 40 centimeters in diameter; reported from: Cag. to Tay.; Min., Bur., Ley., Zambo.

Local names.—Agulasíng (Isa.); aráñgen (I. S.); arupág (Cag.); dáueng (Cag.); kaníwi (Riz.); magtabígi (Ley.); MALASÁGING (Lag., Tay); maligáng (Zambo); salakíng-pulá' (Lag.).

Wood hard, heavy, dense, of finer texture and darker color than tucang-calao, but odor not so pronounced.

A. elaeagnoides Benth. MATAMATÁ.

A tree up to 40 centimeters in diameter; reported from: Zambo., Bas., Malamaui, Sulu Arch., and Palawan, always with above name.

Wood practically identical with malasaging (*A. diffusa*).

A. everettii Merr. BULÓG.

A tree up to 70 centimeters in diameter; reported from: Tay., Ley., Cebu, Neg., Tab., Sur., Bas.

Local names.—Bubúa (Neg.); BULÓG (Neg., Tab.); buñguás (Cebu); lumbanau (Sur.); malasantól (Cebu).

Wood similar to tucang-calao, but somewhat lighter and softer and with less penetrating odor.

A. harmsiana Perk. MALATUMBÁGA.

A tree up to 60 centimeters in diameter; reported from: N. to S. Luz.; Min., Ley., Guim., Agus., Mis., Lan., Cota., Zambo., Bas.

Local names.—Balinsiagáu (Pang.); batukanág (I. S.); bayantí (Lag., Batg.); bayóg (Guim.); daiamiras (Min.); hagáson (Ley.); kaniwi-putí (Lag.); malaságing (Ley., Tay.,); MALATUMBÁGA (Bat.); mamonák (Zambo.); matamatá (Sor.); matáng-uláng (Bat.); palatáñgan (Cag., I. S.); pili-pili (Cam.); salamúñgai (Batg.); sallapugúd (I. S.); saplúñgan (Zambo.); tadiáng-kalabáu (Lag.); tañgíling-bañgóhan (Bul.); tibúñgau (Cag.).

Wood harder, denser, heavier, of finer texture and darker color than tucang-calao, but odor not so strong.

A. laevigata Merr. GISÍHAN.

A tree up to 40 centimeters in diameter; reported from N. Luz. to Bat. and Riz., and from Min.

Local names.—Agai (Bat.); asat (Pang.); GISÍHAN (N. E., Bul., and probably Riz. and Lag.); salñgén (I. S., Pang.).

One of the hardest, heaviest, densest, and finest woods of the genus; in general appearance much like tucang-calao, but much darker and with less odor.

A. llanosiana C. DC. BAYANTÍ.

A tree up to 35 centimeters in diameter; reported from: I. N., to Cam. and from Pal.

Local names.—Balantí or BAYANTÍ (Lag.); malatumbága (Bat.); taba-taba (Cam.). Wood very similar to gisihan.

A. luzoniensis Merr. & Rolfe[1]

A tree up to 40 centimeters in diameter; reported from: N. Luz. to Alb.; Min., Sam., Neg., Sur., Din., Dav., Pal.

Local names.—Bulóg (Min.); gisok-gísok (Din.); kalamismís (Din.); lansones-gúbat (Tay.); madiabug (Tay.); magsinóyo (Sur.); maragutau (Cag.); matamatá (Alb.); sandaná (Neg.); tallán (Cag.). Wood very similar to gisihan.

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[1] The name kuling-manuk is not recorded on any botanical collection of *Aglaia luzoniensis*; it has been recorded from C. Luz. for various species of *Aglaia* not otherwise well known, but commercial specimens of wood from the Laguna de Bay region agree perfectly in color and texture with authentic specimens of this species. The same name is also sometimes given to a yellow wood of this family, possibly a species of *Dysoxylum*.

A. multifoliola Merr. KANSÚLUD.

A tree up to 50 centimeters in diameter; reported from: Ley., Cebu, Neg., Ant., Bas.

Local names.—Gupak (Cebu); KANSÚLUD (Neg.); pilúkau (Ley.); probably also pikpik-uák (Bas.).

Wood very similar to tucang-calao, but lighter in color and with less odor.

A. turczaninowii C. DC. SALAMŨÑGI.

A tree up to 35 centimeters in diameter; reported from: N. Luz. to Cam.; Min., Iling, Tic., Guim., Zambo., Pal.

Local names.—Arángen (I. S.); bulóg (Iling); magitlumbói (Guim.); malatumbága-babáe (Bat.); matamatá (Tic.); SALAMŨÑGI (Cav., Batg.).

Wood very similar in appearance to tucang-calao, but of somewhat finer texture and with less pronounced odor.

Genus AMOORA.

A genus of five or more species, but only one, kato, well known. The wood of the other species, as far as known, is very much lighter and softer, and the trees do not grow as large.

A. aherniana Merr. (Plate IV, fig. 27.) KÁTO.

A tall, straight tree up to 110 centimeters in diameter; reported from: Zam., Bat., Lag., Sam., Zambo.

Local names.—KÁTO (Bat.); malatumbága (Bat., Lag.).

Wood hard; heavy; sapwood 2 centimeters thick, light dull red, rather sharply marked off from heartwood; heartwood deep, dull wine red; grain straight; texture fairly fine, pores showing on longitudinal sections as long, light lines, being almost completely filled with tyloses; seasons well, at least in small dimensions; not difficult to work. Durability II; even sapwood rarely attacked by beetles.

Structure.—Pith rays numerous, fine, distinct, often bending around the pores; pores medium to large, numerous, evenly scattered, the majority completely choked with tyloses, the light color of the latter making them very conspicuous; soft tissue in thin rings about pores; no growth rings.

Uses.—Posts; beams, joists, rafters; flooring; doors, windows, interior trim; furniture and cabinetwork; bridge, wharf, and other heavy construction timber; ties; turned and shaped tool handles.

Supply and prices.—Rare in Manila market and no sales recorded.

Genus APHANOMYXIS.

Beside salakín, here described, one or two other widely distributed species occur, but they are not so well known. The woods seem to be identical. A few local names recorded for the other species are included in the list below.

A. cumingiana Harms SALAKÍN.

A tree up to 50 centimeters in diameter; reported from: N. V., Pang., Pamp., Bul., Bat., Riz., Lag., Batg., Tay., Cam.; other species, besides about this same region, also from: I. S., Cag., Abra, Min., Ley., Sur., Zambo., Pal.

Local names.—Bunglíu (Sur.); busenlói (Abra); balukanág (Batg.); dugarai (Pamp.); palatáñgen (I. S.); SALAKÍN (Lag.); palang-batú (Lag.).

Wood hard; heavy; sapwood about 5 centimeters thick, pale red, sharply marked off from heartwood, but line of demarcation irregular, i. e., not following the growth rings; heartwood rich red, like a dark grade of cigar box cedar; grain straight or slightly crossed; texture fine, smooth, glossy; general appearance similar to that of tucang-calao and other species of *Aglaia;* faint, pleasant odor; seasons well; easy to work and takes a beautiful surface under sharp tools. Durability probably at least III; even sapwood rarely attacked by beetles.

Structure.—Pith rays numerous, fine, but fairly distinct; pores small to medium; soft tissue in numerous, wavy, sometimes branching, concentric lines; in structure, as well as in texture and color, resembling the *Aglaias.*

Uses, supply, and prices.—Little or nothing is recorded of uses; where cut, it is probably confused with the *Aglaias* and put to the same uses (see p. 131), for which, from its beauty of color and texture, hardness and resistance to insects, it is equally as good.

Genus AZADIRACHTA.

A. integrifoliola Merr. MARÁNGGO.

(Bird's-eye calantas or curly calantas.)

A tree up to 100 centimeters or more in diameter; herbarium specimens of this tree have been collected only from Masbate and Palawan, but it is possible that a part of the "curly" and "bird's-eye calantas," etc., of Zamboanga, Basilan Island, and perhaps other parts of Mindanao, is furnished by this or some other closely allied species. The only local names recorded are: Calantas (Min.); MARÁNGGO (Pal.).

Wood on the average slightly harder and heavier than calantas (*Toona* spp.); sapwood 3 to 5 centimeters thick, pale red, not quite sharply marked off from heartwood; heartwood slightly darker red than average calantas; often with conspicuous darker figure formed by dense outer belt of each growth ring; also often with numerous small knots (from less than one-half to two centimeters in diameter), in occasional pieces so numerous and regularly arranged in diagonal rows as to remind one of the tufts or buttons in leather upholstery; odor said to be quite distinct in fresh wood, but disappearing almost completely in seasoning; seasons well, except that knots, though otherwise sound, almost invariably check radially; very easy to work. Durability apparently as good as calantas.

Structure.—Pith rays fine, but distinct; pores medium sized, very irregularly distributed, in some dense belts very few, in other parts very numerous, yet not constituting a regular ring-porous structure; some single, some in short radial strings, others in small irregular clusters and still others tending to form tangential lines; many with dark glistening deposits, which also make the pores conspicuously darker than in calantas in longitudinal sections; soft tissue in thin rings about pores, or small, irregular patches about groups of pores, and also forming conspicuous concentric lines very variable in thickness and spacing; growth rings very erratic, sometimes marked by conspicuous belts of dark, very dense tissue, sometimes over considerable areas very ill defined or almost absent.

Uses.—All uses of calantas, except high grade cigar boxes, for which it has not the requisite odor.

Supply.—In Zamboanga, Basilan and Palawan appears to be more abundant than calantas.

Prices.—Somewhat lower than calantas.

Genus DYSOXYLUM.

A genus of about 25 species in the Philippines, the wood of only a few of which is fairly well known; many species widely distributed, but always scattered; trees of medium height, straight, rarely exceeding 60 centimeters in diameter.

D. decandrum Merr. AGÁRU.

A tree up to 90 centimeters in diameter; reported from: N. Luz., to Cam., Min., Mas., Neg., Dav., Lan., Zambo., Bas.

Local names.—AGÁRU (Pamp.); bagulibás (Bas.); boháue (Min.); buntúgon (Cam.); igíu (Batg.); malaaduás (Occ. Neg.); paluahan (Neg.); pamatágen (Cag.); tadiáng-kalabáu (Lag.); taming-táming (Bas.).

Wood hard; moderately heavy; sapwood 2 to 3 centimeters thick, light yellow, rather sharply marked off from heartwood, but line of demarcation irregular, i. e., not following growth rings; heartwood light yellow when fresh, turning to light yellowish brown, the color shading gradually from the lighter inner edge to the darker outer edge of each growth ring; grain commonly wavy, giving beautiful "changeable silk" effects; texture fine, dense, smooth; distinct, characteristic odor, when fresh reminding one of sandal wood; the odor soon disappears superficially, but is again perceptible on merely scraping the surface; seasons well; works easily. Durability at least II; even sapwood rarely attacked by beetles.

Agaru is very similar in general appearance and mechanical properties to the satinwood (*Chloroxylon swietenia*) of India.

Structure.—Pith rays numerous, fine, distinct; pores small, evenly scattered, becoming scarcer toward outer edge of ring; soft tissue in very small patches about pores and forming a conspicuous, narrow, wavy, light-colored line at the end of the growth ring; width of growth rings very variable, from 1.5 to 10 millimeters.

Uses.—Posts; beams; joists and rafters; ties; flooring; window sills; windows; doors; furniture and cabinetwork; tool handles; a wood which, on account of its beauty of texture, color, and insect-proof qualities should be more used for fine cabinetwork; would make beautiful moth-proof chests.

Supply and prices.—Found only rarely in the lumber market, but during recent years several thousands of hewn ties from the Sulu Archipelago have been brought to Manila and sold at prices ranging from ₱1.50 to ₱1.75 per tie.

D. euphlebium Merr. MIÁO.

A tree up to 50 centimeters or more in diameter; reported only from Laguna and Negros, but commercial material from such widely separated points as Cavite, southern Tayabas and Cotabato indicates that either the same or some very closely allied species is more widely distributed than the botanical collections show.

Local names.—Kuling-bábui (Lag.); MIÁO, paluahan (Neg.).

Wood hard; moderately heavy; sapwood and heartwood scarcely distinguishable, almost white when fresh, turning somewhat yellowish with age, grain straight or somewhat crossed, texture fine; disagreeable odor when fresh, similar to that of batino (*Alstonia macrophylla*); seasons well; easy to work. Durability III, or better.

Structure.—Pith rays numerous, fine, rather indistinct; pores few, small, scattered; soft tissue in numerous, wavy, branching, concentric lines, by far

the most conspicuous feature in cross section; growth rings marked by a more or less distinct, narrow band of denser, darker tissue.

Uses.—Locally used for house construction; in trade schools for carved and turned articles and cabinetwork.

Supply and prices.—Even scarcer than agaru in the Manila market; price would probably not exceed ₱125 per M. for occasional small lots.

D. turczaninowii C. DC. KAYÁTAU.

A tree up to 80 centimeters in diameter; reported from: N. Luz. to Cam., Min., Mar., Pol., Ley., Ilo., Zambo., Pal.

Local names.—Adupar (Cag.); agáru (Pang.); bunglói (Ilo.); gatátan (Cag.); KAYÁTAU (Pal., Bus.,); kuling-manúk (Lag.); lasóna (Ley.); makabongló (Cam.); pupúut (I. S.).

Wood in all respects very similar to agaru, though perhaps of slightly coarser texture and with less pronounced odor even when fresh. Unknown in Manila market.

Genus SANDORICUM.

S. koetjape Merr. (*S. indicum* Cav.). (Pl. IV, fig. 28.) SANTÓL.

A tree up to 70 centimeters or more in diameter; very widely distributed and one of the best-known trees in the Archipelago as, besides being native in most islands, it has been cultivated in many regions since prehistoric times for its fruit. No other name than the above is recorded.

Wood soft; light, specific gravity about 0.576; sapwood extremely variable in thickness, pale red, sometimes with pinkish or violet tinge; heartwood irregular in outline, only slightly darker than sapwood; grain straight; texture fine, smooth; faint, camphor-like odor; seasons well; very easy to work. Durability III; very rarely attacked by beetles.

Structure.—Pith rays fine, moderately thick; pores few, medium sized, often partitioned, scattered singly or in groups of 3 or 4; soft tissue in thin rings about pores and in rather irregularly spaced narrow concentric lines containing numerous pores, which probably mark growth rings; growth rings not otherwise marked.

Uses.—Next to the baticulins and lanete, santol is the favorite for carving and sculpture, especially of sacred images; also hat maker's blocks; used locally for house posts and light framing; ceilings; household implements; furniture and cabinetwork.

Supply and prices.—Not found in the market except an occasional piece among logs rafted or shipped to Manila, or among the miscellaneous lumber of the larger operators; the sculptors buy logs or short bolts, generally from cultivated trees in or near towns, at prices probably not exceeding ₱10 to ₱15 per cubic meter.

S. vidalii Merr. (Pl. IV, fig. 29.) MALASANTÓL.

A tree up to 90 centimeters in diameter; reported from: N. V., Tar., Zam., Bat., Riz., Lag., Tay., Cam., Min., Sam., Neg., Mis., Cota., Zambo.

Local names.—Bagosantól (Riz.); biot (N. V.); magsantól (Zam.); malabobónau (Sam.); malarambó (Riz.); MALASANTÓL (Bat., Riz., Lag., Tay., Cam.).

Wood practically identical with santol and fit for all the same uses; the sculptors seem not even to know of it, though they could probably often get larger and straighter logs from it than from the cultivated santol trees; it has been cut for cheap export railway ties; otherwise, rarely found in the market except among miscellaneous lumber.

Genus TOONA.

A genus of tall, straight trees of three species, of which only one, *T. calantas*, is widely distributed. There is no doubt that practically all of the calantas lumber is derived from this one species, except that from Palawan, Zamboanga and perhaps other parts of Mindanao. Certainly some of the lumber called calantas in this region is from the tree known as curly or bird's-eye calantas (Maránggo, *Azadirachta integrifoliola*), while certain specimens seem to indicate that there exists there also some other, not yet botanically known species of one genus or the other.

T. calantas Merr. & Rolfe (Pl. IV, fig. 30.) CALANTÁS.

A tree up to 150 centimeters in diameter; reported from: I. S., Cag., Isa., Mtn., N. V., N. E., Pang., Zam., Bat., Lag., Tay., Cam., Alb., Sor., Min., Ley., Cebu, Neg., Zambo., Bas., Pal.

Local names.—Añipla (Bats.); bantínen (Mtn., N. V.); daniggá (Cag., Isa.); danuprá (I. N.); kantíñgen (I. N., Zam.); CALANTÁS (Mtn., Pang., Bat., Lag., Tay., Min., Bas., Pal.); lanipgá' (Cam., Alb., Sor., Sam., Ley., Cebu, Neg.).

Wood soft; light, specific gravity 0.438 (Foxworthy), 0.406 (Puigdulles); sapwood small, pale red, rather sharply marked off from heartwood; heartwood light to very dark red, but most frequently of the color of average Spanish cedar (*Cedrela odorata*); grain generally very straight; texture fine or moderately coarse, smooth; strong and lasting odor exactly like Spanish cedar; seasons well, except that thick planks are liable to internal checking if not carefully seasoned; very easy to work. Durability II; heartwood practically never attacked by insects when seasoned, though living trees are sometimes attacked by borers.

Structure.—Pith rays fine, distinct; as a rule, conspicuously ring-porous, inner part of ring containing numerous large pores which gradually or abruptly become much fewer and smaller toward outer part; in some specimens the ring-porous character is somewhat obscured by pores being fewer and more evenly scattered; scanty dark reddish deposits in pores; soft tissue inconspicuous, except in porous belt at beginning of growth ring; growth rings not otherwise marked by difference of color.

Uses.—The only native wood used in Manila for high-grade cigar boxes; also the only wood used by a local factory for piano cases and all internal parts of pianos except the (imported) mechanism; a favorite, on account of its lightness, ease of working and durability, for dugout canoes; also sheathing and ceiling, carving and sculpture; paddles and light oars; automobile mud guards; wardrobes and clothes chests; boats and small launches; ship's cabin finish.

Supply.—Though widely distributed and well known, calantas is nowhere abundant; the supply in Manila is probably rarely equal to the demand.

Prices.—One hundred and forty pesos to ₱180 per M.

T. febrifuga Harms

A tree up to 80 centimeters in diameter; reported only from Zambales and Mindoro.

T. paucijuga Merr.

A small tree, reported only from Leyte.

The wood of these two is calantas.

Genus XYLOCARPUS.

A genus of three or four species in the Philippines, of which two only are well known, piagao and tabigi; practically the only difference between these two is in the color. The "African mahogany" from German East Africa belongs to this genus.

Wood moderately hard; moderately heavy; sapwood small, whitish; heartwood light red (tabigi) to deep wine color (piagao); grain straight or slightly crossed; texture fine, glossy; seasons very well, shrinking little and checking or warping hardly at all; works easily. Durability II; rarely, if ever, attacked by beetles.

Structure.—Pith rays numerous, fine, regular; pores few, small, evenly scattered; soft tissue inconspicuous except for a fine, distinct line at end of growth ring; rings not otherwise much differentiated in color or density; ripple marks present in all longitudinal sections.

Uses.—Poles; ties; posts; beams, joists, rafters; doors; flooring; all interior finish; high-grade furniture and cabinetwork; among the best and most beautiful cabinet woods in the Islands.

Supply.—Limited, as trees are generally scattered, but in one small mangrove swamp area in Agusan about 27 per cent of the total stand is tabigi.

Prices.—Railroad ties of piagao sell with other second-class ties at about ₱1.25; lumber rarely comes into market except mixed with better grades of red lauan; if carefully kept apart, it should bring better prices than the best lauans, especially for export.

X. granatum Koen. (Pl. IV, fig. 31.) PIAGÁO.

A tree of the mangrove swamps, up to 65 centimeters in diameter, but straighter and sounder than tabigi; reported from: Bat., Tay., Min., Neg., Sib., Guim., Mis., Cota., Zambo., Pal., and Pangutaran; probably found in all mangrove swamp areas.

Local names.—Lagut-út (Guim.); nígi (Tay., Pal.); tabígi or tibígi (Min.); piadák (Pal.); PIAGÁO (Min., Neg., Guim., Cota., Zambo.); pu-yugáu (Tic.); sangkuyung (Zambo., Sulu Arch.).

X. obovatus A. Juss. TABÍGI.

A tree up to 100 centimeters in diameter; reported from: Cag., Tay., Pal., Cam., Sor., Min., Mas., Mar., Ley., Cebu, Neg., Ilo., Sur., Din., Agus., Mis., Lan., Cota., Zambo., Bas., Cul., Pal.; probably found in all mangrove swamp areas.

Local names.—Kulimbáning (Cul.); lubanáyong (Cag.); nígi (Tay., Cam., Min., Cul., Pal.); piagáu (Mas., Zambo.); pulit (Bas.); TABÍGI (Tay., Cam., Sor., Mas., Mar., Neg., Cebu, Ilo., Guim., Din., Agus., Lan., Cota., Zambo., Pal.).

EUPHORBIACEAE.

[Binunga family.]

A very large family, but containing few timber trees of any importance in the lumber trade. The only large tree that is very widely distributed is tuai; the various species of *Cyclostemon* are very widely distributed and furnish wood which, though not durable when exposed, is useful for all sorts of interior work; while two other woods, lumbang and gubas, are among the best in the Islands for matches and match-box veneers.

The woods of this family vary widely in weight, color, and hardness; in

structure certain common features are found in a great many species. The pores are generally few, scattered, and small or medium sized; pith rays generally fine and numerous; soft tissue very often forming numerous more or less distinct, sometimes interrupted, sometimes continous concentric lines.

Genus ALEURITES.

Two species in the Philippines, with wood practically identical.

Wood light; soft; whitish, staining to gray, or light brown; no distinct sapwood and heartwood; grain straight; texture rather coarse. Durability poor.

Structure.—Pith rays numerous, fine, indistinct; pores numerous, small to medium, scattered or in short radial strings; soft tissue inconspicuous, in numerous, indistinct, interrupted concentric lines; no growth rings.

Uses.—Wooden shoes, matches.

Supply.—Limited.

Prices.—Not marketed except perhaps occasionally with miscellaneous lumber and in the shape of match logs, for which the manufacturers pay about ₱9 per cubic meter.

A. moluccana Willd. LUMBÁNG.

A tree up to 150 centimeters in diameter, with a short but regular bole; reported from: Riz., Lag., Cav., Batg., Mis., Dav., Lan., Zambo., Pal.

Local names.—Biáu (Mindanao); LUMBÁNG (Riz., Lag., Batg.); lumbáng-batú (Cav.); the "candle-nut tree."

A. trisperma Blco. BALUKANÁD.

A tree similar to the preceding; reported from: Riz., Cav., Lag., Batg., Tay., Cam., Neg., Dav.

Local names.—Bagilumbáng (Lag., Tay.); BALUKANÁD, balukanág, banukalád, or lumbáng-banukalád (Cav., Lag.); lumbáng-gúbat (Cav., Batg.); tan'ág-laláki (Riz.).

Genus BISCHOFIA.

B. javanica Bl. (Pl. IV, fig. 32.) TUÁI.

A tall, straight tree, up to 150 centimeters in diameter; reported from: I. N., Cag., Abra, Bont., Beng., N. V., N. E., Un., Tar., Bat., Riz., Lag., Cav., Batg., Tay., Cam., Alb., Min., Mas., Sam., Cebu, Neg., Camig., Agus., Lan., Dav., Pal.

Local names.—Apálang, ayuní (Bat.); bagná (Bat.); duég (I. N., Tar.); kanarém (Un.); maladísai, mandos (Agus.); sumuandud (Dav.); tóob (Tay.); tóog (Tay., Cam., Tab., Min., Sam., Neg.); tuá' (Riz., Lag.); TUAÍ (Bat., Cav., Alb., Min.); tuáu (Min.); tuél (Abra); túol (Ifug.); tuwe (Lep.).

Wood moderately hard; heavy; sapwood light cream color to reddish brown, 2 to 4 centimeters thick, not quite sharply marked off from heartwood; heartwood dark reddish brown with purplish tinge; grain straight or somewhat crossed; texture coarse, rough, dull; decided odor of vinegar when fresh; checks and warps badly if not seasoned very carefully; fairly easy to work. Durability said to be excellent underground; otherwise III.

Structure.—Pith rays fine, numerous, indistinct, pores small to moderately large, numerous, scattered or in radial lines of 3 or 4; soft tissue in small, irregular patches about pores, and numerous, fine, indistinct cross-lines between rays; occasional whitish deposits in pores and pith rays;

growth rings in young trees marked by ill-defined belts of porous tissue, in old trees hardly noticeable.

Uses.—Posts above stumps; beams, joists, rafters; flooring; foundation piling; recommended for treated ties, mine timbers and paving blocks.

Supply and prices.—Not marketed separately as a rule, but sometimes substituted, fraudulently or ignorantly, for betis and other heavy dark red woods; otherwise sold with heavier miscellaneous lumber, selling at ₱50 to ₱70 per M.

Genus CYCLOSTEMON.

A genus of 20 or more species in the Philippines; trees reaching ordinarily about 60 centimeters in diameter, occasional specimens considerably larger, one on record of 175 centimeters; straight and moderately tall; very widely distributed, but scattered; apparently most abundant in parts of Mindanao.

Wood of all species practically identical; hard; heavy; sapwood and uncolored heartwood almost indistinguishable, creamy yellow when fresh, often turning in seasoning to various mottled grays and light browns; colored heartwood rare, small, irregular in outline, curiously mottled in brown, greenish brown and black, resembling specimens of streaky camagon (*Diospyros* spp.); grain very straight; texture fine, dense, very smooth; seasons badly in log, staining considerably and splitting very deeply at ends, but if sawn while fresh and carefully stacked, seasons with little staining and checking; not hard to saw and, for a hard wood, rather easy to shape and surface. Durability III, but not attacked by beetles.

Structure.—Pith rays numerous, crooked, fine but distinct; pores small to medium, evenly scattered or with a slight tendency to form short radial rows; soft tissue in thin rings about pores and in numerous, irregular, short transverse lines between rays, of same width, color and spacing as rays and forming a fine, square-meshed, lace-like pattern with them; growth rings indistinct or marked by a narrow belt of dark, dense tissue.

Uses.—Posts above stumps; beams, joists, rafters; flooring; interior finish, moldings, etc.; furniture and cabinetwork; rice mortars and pestles; turnery; would make an excellent paving block if treated.

Supply.—Scant; little appreciated for construction on account of lack of durability under severe conditions and so not cut by small loggers; in large operations included with "miscellaneous;" small lots from central or southern Luzon sometimes found in market with the name tinaan-pantai; in Mindanao mills the names magataru and banaui are best known.

Prices.—Generally sold with miscellaneous lumber, but good boards for flooring, etc., sell as high as ₱100 or over per M.

The local names are very loosely applied and the following is a list of all local names recorded for the whole genus:

Local names.—Agulasíng, gulasíng (Cag.); apálang (Tay.); bagatáru (Cam.); balikbíkan (Bat., Batg.); BANÁUI (Cota., Zambo., Bas.); batínong-dágat (Tay., Cam.); BATO-BATÓ (Min., Cuyo, Pal.); bokbók (Tay.); butigáu (Neg.); butíg-bábui (Riz.); BUTONG-MANÚK (Bat., Cam., Min.); damól (Sam.); dagiñgíran, dañgíran (Cag.); gakakan (Cag.); girigitík (Sor.); gulipápa (Cag.); hinlap-bagió (Sam.); kauál (Negrito of Cag.); lumakáu (Cam.); lúnas (Lag.); magapisa (Cota.); magatáru (Mis., Cota.); malitambíng (Sor.); manghás (Taw.); margabólo (Lag.); marimáu (Agus.); matobató (Mas.); ñgarosáñgis (I. S.); onaslúm (Neg.); pañgardísen (Pang.); pañgapaktulen (Cag.); pañgaráñgin (Bat.); pasaklák (Un.); pugúran (Min.); putían (Min.); putíg (Zambo.); talang-idóng (Tay.);

talimórong (Pamp., Bat.); talulóng (Tay.); tañgísang-bagió (Tay.); taradák (Cota.); tayumtáyum (Bat.); TINÁAN-PANTÁI (Tay., Cam.); tingkál (Zambo.); tumbong-uák (Pal.).

The following are the largest and most widely distributed species of *Cyclostemon:*

C. bordenii Merr. TINÁAN-PANTÁI.

A tree up to 95 centimeters in diameter; reported from Cag., N. E., Pamp., Bat., Tay., Min., Sam., Ley., Cap., Sur.

C. grandifolius C. B. Rob. BANÁUI.

A tree up to 40 centimeters or more in diameter; reported from Cota., Zambo., Bas.

C. littoralis C. B. Rob. BATOBATÓ.

A tree up to 175 centimeters in diameter; reported from: Cag., Un., Bat., Lag., Cam., Zambo., Pal.

C. microphyllus Merr. BUTONG-MANÚK.

A tree up to 75 centimeters in diameter; reported from: Cag., Pang., Bat., Lag., Tay., Cam., Min., Mas., Agus., Zambo.

Genus ENDOSPERMUM.

E. peltatum Merr. GÚBAS.

A moderately tall, straight tree, up to 75 centimeters in diameter; reported from Beng., Bat., Riz., Lag., Tay., Cam., Alb., Sor., Min.

Local names.—Biluáng (Cam., Alb., Sor.,); binuáng (Bat., Riz.); binúñga (Bat.); buluáng (Min); ginabang (Beng.); GÚBAS (Lag.); indáng (Lag.); kalúkoi (Bat.); malasabón (Lag.).

Wood light; soft; no distinct sapwood and heartwood; nearly white, turning straw color on exposure, but often staining to light gray if not seasoned quickly; grain very straight, pores showing as long, scattered brownish lines; texture fairly fine, smooth, but not glossy; seasons very well, except for staining; very easy to work. Durability IV, but not often attacked by insects.

Structure.—Pith rays fine, distinct, irregularly spaced; pores medium sized, few, scattered singly or in radial rows of 2 to 4 or 5; soft tissue forming very regular, somewhat wavy concentric lines about one fourth millimeter apart; no growth rings.

Uses.—Match and match-box veneer; wooden shoes; used, on account of its straight grain and ease of working, for sticks of cheap umbrellas in one Manila factory.

Supply.—Limited.

Prices.—Marketed with cheap miscellaneous lumber, or as match logs, which bring about ₱9 per cubic meter.

Genus SECURINEGA.

S. flexuosa Muell.-Arg. ANISLÁG.

A tree up to 50 centimeters or more in diameter, with a short and often irregular bole; reported from: Tay., Cam., Sor., Sam., Ley., Cebu, Neg., Camig., Sur., Agus., But., Mis., Dav.

Local names.—Amislág or hamislág (Cam., Alb., Sor.); ANISLÁG (Sam., Neg., Agus., Sur.); cacao-cacáo (Cam.); maláñgau (Agus.); tras (Cota.).

Wood moderately heavy; moderately hard; sapwood small (1 to 2 centimeters), scarcely distinguishable in color; heartwood reddish brown with

irregular darker streaks; grain straight; texture fine, dense smooth; liable to warp somewhat if not carefully seasoned, otherwise seasons well; rather easy to work. Durability probably at least III, not attacked by beetles.

Structure.—Pith rays numerous, 3 to 8 very fine ones between every two fine ones; pores numerous, small, very evenly distributed singly, or in radial rows of 2 to 5; soft tissue hardly visible; growth rings faintly indicated by lighter and darker belts.

Uses.—House posts; joists and rafters; agricultural implements; tool handles.

Supply.—Scarce, but well and favorably known wherever it occurs.

Prices.—Not regularly marketed; if an occasional log is sawn, would be sold with miscellaneous lumber.

ANACARDIACEAE.

[Mango family.]

A large family furnishing a number of very different woods, but none of great importance, partly because the trees are scattered or comparatively small, partly because many of the woods lack either strength or durability. Several, however, are very good for interior work.

Genus BUCHANANIA.

A genus of six or more species of small to medium sized trees with a straight bole having a maximum reported diameter of 70 centimeters. One or more species are found in probably every province. The wood of all species is practically identical; the same local names are applied to all indifferently and are here given for the whole genus without regard to species.

Local names.—Alitagtág (Cam.); anagás (Tic.); anám (Bis.); anán Min., Guim.); anténg (I. N.); amúgis or hamúgis (Alb.); aráñgas (I. N., N. E.); aráñges (Cag.); bagulibás (Min.); baláñga (Guim.); balayóhot, balíbud (Tag.); baligóhot, balióhod (Tay., Cam.); BALINGHÁSAY (Bat., Tar., Lag., N. E.); balitangtáng (Lag., Tay.); bangkaláuang (Tag.); basákan (Mindoro); boróan, buhían (Pang.); butubutú (Cebu); diláan (Zam.); gañga (Cag.); hupong-húpong (Bkl.); kamúng (Cag., Zam.); kanteng (Abra); karantáng (Pal.); kokatmón (Sur.); ligás (Cam.); lıñgabunu (Bas.); maguliók (Tay.); malabalúnu or manbalúnu (Zambo.); malaligás (Tay.); mañgián (Lan.); palangkomóg, paleng, pappágan (Cag.); palinlín, pamilín (Zam.); páo (Pang.); pusopúso (Min.); ráñgas (Pang.); riñgas (I. N.); rúñgus (Cag.); sambrit (Cag.); tagangtáng (Mas., Tic.); tiók (Tay.); uyók (Beng.).

The best known species is:

B. arborescens Bl. BALINGHÁSAY.

Wood moderately heavy; soft to moderately hard; sapwood large, pinkish white, not always sharply marked off from heartwood; heartwood pink to light reddish brown; texture rather fine and even; grain straight, but frequently with numerous small knots; seasons well and works very easily. Durability IV; sapwood often attacked by beetles.

Structure.—Pith rays fine, indistinct, brighter red than hard tissue; pores small to moderately large, scattered; soft tissue same color as pith rays, forming small patches about pores. Structure as a whole similar to amugis, but lighter in color and less dense. Growth rings, if present, not sharply defined.

Uses.—Light construction; flooring; interior finish; house posts above

stumps; joists and rafters; furniture; household implements; musical instruments (necks); cheap cigar boxes; dry measures; boxes.

Supply and prices.—Scant; comes into Manila in occasional small lots; larger operators mix it with miscellaneous lumber; sometimes sold as amugis, but otherwise would not bring more than ₱40 to ₱60 per M.

Genus DRACONTOMELUM.

Three species, of which one, dao, is very well known, though the wood is comparatively little used; lamio is less well known and only used locally or, in large lumber operations, sawn with miscellaneous stuff, while the third, *D. edule* Merr., has been reported only from Palawan and its wood is unknown.

D. cumingianum Baill. LAMIÓ.

A tall, straight tree, up to 60 centimeters or more in diameter reported from: Bul., Bat., Riz., Lag., Batg., Tay., Cam., Sor., Sam., Tab., Cota.

Local names.—Aduás (Riz.); alauíhau or halauíhau (S. Luz., Sam., Ley.); bili-bíli (Tab.); bió (Pang.); LAMIÓ (Bul., Bat., Riz., Lag.).

Wood in all respects similar to following, but slightly softer and lighter in weight and color. If brought to Manila market, sold with miscellaneous lumber and used for cheap construction, etc.

D. dao Merr. & Rolfe DAO.

A tall tree, up to 100 centimeters or more in diameter; when in open situations the bole is often crooked, in the forest generally straight, but always with enormous thin buttresses, sometimes up to 6 or 8 meters in height; reported from: Cag., Bat., Riz., Lag., Tay., Cam., Sor., Min., Sam., Ley., Mas., Neg., Agus., Dav., Cota., Zambo., Pal.

Local names.—Batúan (Bis.); DAÓ' (Bat., Riz., Lag., Tay., Cam., Sor., Min., Mas., Sam., Ley., Neg., Cota., Zambo., Pal.); habás (Agus.); hamárak (N. Luz.); kiakía (Ley.); lupigi (Cag.); makadáeg (I. N.); mamakau (Dav.); makau (Agus., Cota.); malaíyau (Tay.).

Wood moderately hard; moderately heavy; sapwood very large, light colored with pinkish or brownish tinge, rather sharply distinguished from heartwood; heartwood brownish or greenish gray, with irregular dark brown or almost black streaks; texture fairly fine; grain straight; liable to warp if not carefully seasoned; not difficult to work and takes a beautiful polish. Durability III or better; heartwood rarely attacked by insects.

Structure.—Pith rays fine, light colored, distinct; pores moderately large or large, scattered singly or in groups of 2 or 3, with dark glistening deposits; soft tissue in very thin rings about pores; growth rings, if present at all, very indistinct.

Uses.—Posts above stumps; beams, joists, rafters; flooring, sheathing, ceiling; door panels; interior finish; furniture and cabinetwork; dugout canoes; from the buttress roots solid cartwheels, washbowls, and round and rectangular tables are made.

Supply.—Scant; rarely brought to Manila market.

Prices.—Occasional lots of good boards for flooring or other structural material bring from ₱80 to ₱100 per M.

Genus KOORDERSIODENDRON.

K. pinnatum Merr. (Pl. V, fig. 33.) AMÚGIS.

A tall straight tree, up to 100 centimeters in diameter; reported from almost every island and province in the Archipelago.

Local names.—AMÚGIS, ambúgis and múgis (Bul., Bat., Riz., Lag., Tay., Cam., Alb., Sor., Min., Mas., Mar., Zambo., Pal); bangkahási, bangkalári, (I. S.); dañgíla (Tag.); gagil (Zambo.); kalumánog (Bis.); kantíñgen (Un.); karogkóg (Bkl.); lakolako (Bis.); magalibás (Zambo.); magu-yabud (Sam.); marasantog (N. Luz.); sambalagán, sambulauán (Bis.); sarga (I. S.); taligáan (I. N.); twi (Neg.); óris, úris (I. N.); urísan (Cag.).

Moderately hard to hard; moderately heavy to heavy; sapwood 3 to 5 centimeters thick, pale dull red, rather sharply marked off from heartwood; heartwood dull coppery red; texture fine; grain generally straight, sometimes with very short, regular waves and often with numerous very small knots. Durability III; rarely attacked by insects.

Structure.—Pith rays very fine, numerous, bending around pores, distinctly lighter than hard tissue; pores uneven in size and form, numerous, very evenly scattered, sometimes with dark, glistening deposits; soft tissue scarce, forming very thin rings about pores; growth rings, if present at all, generally very indistinct; ripple marks sometimes present, but never conspicuous.

Uses.—Beams, joists, rafters, flooring; interior finish; carriage bodies; furniture and cabinetwork.

Supply.—Scant.

Prices.—One hundred and thirty pesos to ₱150 per M.

Genus MANGIFERA.

A genus of six or more species, of which by far the best known is the mango (*Mangifera indica* L.), which is one of the most widely cultivated fruit trees in the Islands. As a timber tree, the first species described is the best known of the genus.

M. altissima Blco. PAHÚTAN.

A tall tree up to 80 centimeters or more in diameter; reported from: Cag., I. S., N. E., Zam., Bat., Riz., Lag., Tay., Cam., Min., Mas., Sib., Dav.; a wood known as manggapóli in Zamboanga is apparently identical with it, but may be of a different species.

Local names.—Banitan (Cag.); malapahó (Zam., Sib.); manggapóle (Olu., Zambo.); páho', páhu' (Pang., N. E., Bat., Riz., Cam., Min., Sib., Sam.); PAHÚTAN, pahuhútan (Zam., Bat., Tay., Min., Mas.); pañgahútan (Tay.); pangmanggáen (I. S.).

Moderately hard; moderately heavy; sapwood very large (10 to 25 centimeters thick) whitish with pale yellow, brownish or grayish tinge, sharply distinguished from heartwood; heartwood dark brown with alternating light and dark bands; texture rather fine; grain often wavy and curly, interrupted by large, but generally sound knots; seasons well except that large knots sometimes check, and sapwood is liable to stain if not seasoned quickly; easy to work and takes a beautiful finish. Durability III; sapwood not attacked by insects, but poor exposed to weather.

Structure.—Pith rays fine, indistinct, whitish; pores small, scattered; soft tissue forming small, irregular patches surrounding pores, and fine, straight, not very conspicuous concentric lines; growth rings irregular and indistinct, bounded by a fine, indistinct, lighter-colored line.

Uses.—Posts above stumps; beams, joists, rafters; door panels; flooring; sheathing and ceiling; furniture and cabinetwork; cheap clothes chests; musical instruments.

Supply.—Scant.

Prices.—Rarely sold alone under its own name, but mixed with miscellaneous lumber selling at ₱40 to ₱50.

M. indica L. MÁNGGA OR MANGO.

The mango is found only in cultivation; the wood is used occasionally for household implements, etc.; it resembles the sapwood of pahutan, seeming to lack, even in large trees, the dark-brown heartwood of the latter.

M. monandra Merr. MALAPÁHO.

A tall tree, up to 75 centimeters or more in diameter; reported from: Pang., Zam., Bat., Riz., Lag., Cam., Sam., Ley., Tic.; lumber from Sibuyan and from Zamboanga seems to be of this species also.

Local names.—Kalamansánai (Riz., Lag.); kárig (Bat.); kurig (Zam.); MALAPÁHO (Cam., Tic., Sib.); manggatsapúi (Riz.); pagsaguáu (Ley.); paglumbóien (Pang.).

Wood like sapwood of pahutan, but almost white, and having apparently no dark heartwood in even very large trees. Finishes with beautiful silky gloss.

Uses.—Interior finish; furniture and cabinetwork; when mixed with lauans and miscellaneous lots, used for all ordinary purposes.

Supply.—Not as common as pahutan; known in commerce so far only from Zamboanga and Sibuyan.

Prices.—Sold mixed with white lauans and miscellaneous lumber, at prices ranging from ₱40 to ₱50 per M.

Genus PARISHIA.

P. malabog Merr. MALÁBOG.

A tall straight tree, up to 120 centimeters or more in diameter; reported from: Bat., Tay., Sor., Min., Iling, Mas., Tic., Tab., Cebu, Neg.

Local names.—Bulábog (Tab.); kupang-kúpang (Sib.); MALÁBOG, malíbog or mulábog (Bat., Sor., Min., Iling, Mas., Tic., Cebu, Neg.).

Wood moderately hard; moderately heavy; sapwood 10 to 15 centimeters thick, whitish, but generally staining to dull, mottled grayish brown on drying, rather sharply distinguished (even when dry) from heartwood; heartwood irregular in outline, light reddish brown; texture fine; grain straight; liable to warp in seasoning, but works easily and takes a smooth, glossy finish. Durability III.

Structure.—Pith rays fine, numerous, distinct but not conspicuous; pores small, evenly scattered; soft tissue inconspicuous, forming thin rings about pores; growth rings, when present, very indistinct; whole structure similar to amugis, but lighter in color and slightly coarser.

Uses.—Used locally for dugout canoes and for ordinary construction; when marketed with miscellaneous lumber, used for all ordinary purposes.

Supply.—Distribution limited, trees scattered, fairly numerous in a few places (Iling Island and Negros.).

Prices.—Comes into market only with miscellaneous lumber selling at about ₱40 per M.

Genus SEMECARPUS.

A genus of about 12 species of small to medium-sized trees, up to 50 centimeters in diameter, all, as far as known, with wood of the same character. One or more species are found in almost every island and province. The local names are applied very loosely and are here given for the genus without regard to species.

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Local names.—Agás (Guim.); anagás or hanagás (Min., Neg., Guim.); iñgás (Cam., Zambo.); kamíing (Pamp., Zam., Bat.); kamíling (Abra); kamíring (Cag., Un.); LIGÁS, with various qualifying additions (N. E., Zam., Bat., Riz., Lag., Tay.); malamanggá (Pamp., Zam., Tay., Min.); manalu (Zambo.); pákak (Bont.); palanto (Cag.); tañgás (Neg.); tókod-lañgit (Riz.); tópo (Cam.).

The best known and apparently most widely distributed species is:

S. cuneiformis Blco. (*S. perrottetii* March.). LIGÁS.

A tree up to 35 centimeters or more in diameter; reported from: Nueva Ecija to Laguna; Guim., Pal. Known through practically its whole range as kamíring or LIGÁS.

Light; soft; whitish when fresh, but frequently staining to yellowish, faint greenish or brownish tints in drying; colored heartwood, as far as known, absent; texture rather coarse; grain straight; very easy to work. Durability IV.

Structure.—Pith rays moderately fine, numerous, distinct but not conspicuous; pores moderately large, rather even in size, very evenly scattered singly or in close groups of 3 to 4; soft tissue forming distinct rings (or sometimes elongated patches) about pores, and irregularly spaced and broken, fine concentric lines; growth rings, when present, very indistinct and irregular.

Uses, supply and prices.—As most or all species possess poisonous properties similar to those of poison ivy and other species of *Rhus*, besides furnishing inferior wood, smaller operators rarely or never cut the trees and so no logs are shipped to Manila. The larger operators ship small quantities occasionally, mixed with miscellaneous lumber of the most ordinary kinds, selling at not over ₱40 to ₱50 per M., and used for cheap and temporary construction, box lumber, etc.

SAPINDACEAE.

[Alupag family.]

A very large family, but containing in the Philippines only two well-known timber trees, alupag and malugay. Though quite variable in mechanical properties and general appearance, most of the woods have several features in common in their structure. The pith rays are generally fine; pores comparatively few and scattered, very commonly with numerous tyloses which in cross section make the pores appear to be entirely filled with soft tissue and in longitudinal section show as thin cross partitions giving the pores a regularly dotted appearance; growth rings very commonly marked by a fine light-colored line.

Genus EUPHORIA.

A genus of about five species, of which only one is widely distributed and well known.

E. cinerea Radlk. (Pl. V, fig. 34.) ALUPÁG.

A small to medium-sized tree, up to 60 centimeter in diameter; reported from: I. N., Cag., I. S., Isa., Beng., N. E., Pang., Pamp., Zam., Bat., Riz., Lag., Batg., Tay., Cam., Min., Mas., Mar., Sam., Ley., Neg., Mis., Cota., Zambo., Olu., Bas., Pal.

Local names.—ALUPÁG, alupák, alupaí, arupág, ayupág, etc. (N. E., Pamp., Zam., Bat., Riz., Lag., Batg., Tay., Cam., Min., Mar.); apálong

(Cag., N. Tay.); baít, bayít (Tay.); balík (Zambo.); balít (Neg.); bakkaláu or bakaláu (I. N., I S., Cag., Zam.); bakeles (Pang.); bukkaláu (Cag.); halupág, halupák (Lag., Tay., Cam.); kandong-ísol (Mas.); lupák (Cam.); lupál (Cota.); mamatá (Olu.); maraútong (Cag.); matamatá (Zambo.).

Wood very hard; very heavy, specific gravity 0.910 (Valdes), 0.960 (Gardner); sapwood pale reddish, merging gradually into heartwood, in very old trees rather sharply distinguished from it; heartwood light coppery red to dark reddish brown; grain slightly crossed, often wavy; texture fine, dense, very smooth; seasons well; difficult to work, but takes a beautiful surface under sharp tools. Durability I; very rarely attacked by insects.

Structure.—Pith rays numerous, very fine, indistinct; pores few, scattered singly or in short radial rows, many completely choked with tyloses; soft tissue inconspicuous.

Uses.—Posts and sills; beams, joists, rafters; flooring; burrs in native rice mills; teeth of cogwheels in primitive sugar mills, presses, etc.; bearings; wooden anchors; combs; treenails; harrow teeth and other parts of agricultural implements.

Supply.—Scarce; rarely comes to Manila market except in lots of a few logs or mixed with better grade of miscellaneous lumber of larger operators.

Prices.—Dimension stuff in miscellaneous lots will sell at ₱100 or up, good lots of boards or squares for construction about ₱150 per M.

Genus LITCHI.

One species in the Philippines. The well-known Chinese fruit lichee belongs to this genus.

L. philippinensis Radlk. ALUPÁG-AMÓ.

A tree up to 90 centimeters in diameter; reported from: Pang., Zam., Bat., Cam., Alb., Sam., Sib., Agus.

Local names.—Alupág, etc., as for above species; ALUPÁG-AMÓ' (Tay.); aningnaí (Pang.); balít (Sib.); bulála (Cam.); kagasákas, kagsákan (Alb.).

Wood practically identical with alupag and sold as such when brought to Manila market.

Genus NEPHELIUM.

A genus of five species, but only one widely distributed.

N. mutabile Bl. BULÁLA.

A tree up to 40 centimeters in diameter; reported from: Cag., Pang., Batg., Riz., Lag., Cam., Alb., Sam., Ley., Sur., Lan., Zambo.

Local names.—Bakaláu (Pang.); balí' (Zambo.); balimbíñgan (Lan.); BULÁLA (Lag., Cam.); santías or sintíyas (Riz.).

Wood also very similar to alupag, used locally for same purposes, but rarely cut for the market.

Genus POMETIA.

One known species, very widely distributed and, where fairly abundant, well and favorably known.

P. pinnata Forst. (Pl. V, fig. 35.) MALÚGAY.

A moderately tall, straight tree up to 100 centimeters in diameter; reported from: Bab., I. N., Cag., Lag., Cam., Cat., Min., Mas., Tic., Sam., Ley., Ilo., Cebu, Neg.

Local names.—Agupañgá (Min.); alauíhau, aloího (Sam.); balambanan

(I. N.); bangkálan (Sur.); bantañgáli (Agus.); bayóto (Pal.); bidóso, bióso (Min., Pal.); íbu (Cebu, Neg.); kabakabát (I. N.); karunián (Min.); kiá-kiá (Sam., Ley., Cebu,); kugík (Cat.); kúbi (Ilo.); lupañgá, lupañgán (Zambo., Manukmanka, Sulu); madaló (Cag.); MALÚGAY (Lag., Min.); manggís (Pal.); minanúkai (Neg.); oiakiá, uiakiá (Min.); sadai (Bab.); takugan, takúpan (Mas.); tanábog, tanóbong (Pal.); tigáui, tugáui (Cam., Mas., Tic.).

Wood moderately hard to hard; flexible and tough; bends well when steamed (Gardner); moderately heavy, specific gravity 0.658 (Gardner); sapwood 3 to 5 centimeters thick, pale reddish, not quite sharply distinguished from heartwood; heartwood light red; (certain specimens of commercial material from Mindanao have a dark reddish brown heartwood; this may be some local variation or perhaps the wood is from some as yet unknown species of *Pometia*); grain somewhat crossed, often with a characteristic regular wave; texture fine, smooth; seasons well; fairly easy to work. Durability III; sapwood commonly attacked by beetles, attacks sometimes extending into heartwood, but clear heartwood less commonly touched.

Structure.—Pith rays fine, indistinct; pores few, medium sized or small, scattered, with tyloses as in alupag; end of growth ring marked by a fine, light-colored line.

Uses.—Posts above stumps; beams, joists, rafters; flooring; sheathing, ceiling and other interior finish; boat building; masts and spars; ax, pick, rake, and hoe handles; levers, capstan bars, peavies, etc.; minor tool handles; furniture and cabinetwork; recommended for trial for tight cooperage; also for gymnastic apparatus.

Supply.—Little cut for Manila market as there is no demand for it on account of its not being well known; considerable quantities could be obtained from various regions, especially Mindoro.

Prices.—One hundred pesos to ₱120.00 per M.

RHAMNACEAE.

[Balacat family.]

A family containing in the Philippines only one genus of timber trees.

Genus ZIZYPHUS.

A genus of about 13 species, of which only three are widely enough distributed and of sufficient size to furnish any amount of saw timber. The wood of all species is practically identical in structure and general appearance and is known in the market as balacat, the name of the largest and commonest one.

The local names seem to be applied to various species almost indifferently and are here given for the genus without regard to species.

Local names.—Aligámen, ligámen (I. N., I. S.); alínau (I. N.); alisaláñga (Neg.); BALÁCAT (N. E., Tar., Zam., Bat.); baliknít (I. N.); biaá (Riz., Lag.); bigá, bigaá and LIGAÁ (Bat., Bul., Riz., Lag., Tay., Cam., Alb., Min., Mas., Sam., Ley.); dagáau (Sur.); dalipatsán (Mas.); diáan (Pang.); dikláb or dikláp (I. N., I. S.); diráan or dir'án (I. N., I. S., Cag., Tar.); DUKLÁP (Bat., Riz., Cav., Batg.); dukuláb (Bat.); labalaba (Pang.); limiggién (Cag.); maglangká' (Pal.); malipaga (Tay.); mañgaluás (Cota.); maraútong (I. N.); matáng-hípon (Riz.); pirokálau (Cam.); salindáñgat (Neg.).

Wood moderately hard to hard; moderately heavy, specific gravity 0.517 to 0.578 (Gardner); sapwood small, scarcely distinguishable from uncolored

heartwood; uncolored heartwood pale yellowish white, sometimes with faint reddish tinge; colored heartwood apparently very rare; a very wide plank from Cagayan shows a distinct light red heart about 20 centimeters wide, logs of an unknown species from Bataan a small light brown heart, and planks from Cotabato a small heart irregularly streaked with light red; grain slightly crossed, sometimes rather wavy; texture fine, smooth; seasons well; easy to work. Durability IV; often attacked by shot-hole borers.

Structure.—Pith rays fine, distinct; pores medium sized, some in short radial lines, some in wavy tangential lines or scattered; soft tissue in small patches about pores, generally elongated tangentially and often confluent in irregular, short, wavy lines; end of growth ring marked by a belt of dense tissue with few and small pores, sharply marked off from more porous beginning of following ring. (Plate V, fig. 36.)

Uses.—Cheap or temporary construction; ordinary furniture; flooring; agricultural and household implements; wooden shoe soles.

Supply.—Scant; rarely comes into Manila market except in miscellaneous lots.

Prices.—When sold alone, good boards or dimension stuff for house construction bring ₱60 to ₱65 per M.

The following are the best-known species of *Zizyphus*:

Z. inermis Merr. LIGAÁ.

A tree up to 45 centimeters or more in diameter; reported from: Lag., Cam., Alb., Mas., Sam., Ley., Neg., Agus., Zambo., Pal.

Z. trinervia DC. DUKLÁP.

A tree up to 30 centimeters or more in diameter; reported from: I. N., I. S., Beng., Bul., Pang., Un., Bat., Riz., Cav., Tay.

Z. zonulata Blco. (Pl. V, fig. 36.) BALÁCAT.

A tree up to 120 centimeters in diameter; reported from: I. N., Cag., I. S., N. E., Pang., Tar., Bat., Riz., Lag., Tay., Cam., Min., Mas., Ley., Sur., Agus., Dav., Zambo., Pal.

MALVACEAE.

[Malubago family.]

The four woods here described all have a faint odor of roses when freshly worked, being, with narra, the principal woods entitled to the names of Philippine rosewood.

Genus BOMBYCIDENDRON.

B. campylosiphon Warb. LANÚTAN.

B. vidalianum Merr. & Rolfe (Pl. V, fig. 37.) VIDAL'S LANÚTAN.

LANÚTAN (N. Luz. to Bul. and Bat.); losóban (Abra); pañgardísen I. S., Cag.); takúlau blanco (I. N.). This must not be confused with the "white lanutans" of the family *Anonaceae*.

Wood moderately hard to hard, flexible and tough; moderately heavy to heavy, specific gravity 0.732 (Foxworthy) but some pieces much lighter; sapwood 1.5 to 5 centimeters thick, yellowish white, generally rather sharply distinguished from heartwood; heartwood when fresh light to dark purple, fading in time to dull purplish brown; grain straight or slightly crossed; texture fine and smooth; seasons well; fairly easy to work. Durability III, but rarely if ever attacked by beetles.

Structure.—Pith rays fine, distinct; pores numerous, small, scattered;

soft tissue in thin rings about pores; ripple marks always present, fine but distinct.

Uses.—Posts, beams, joists and rafters of small houses; ax and similar tool handles; carriage shafts; singletrees; gunstocks; backs and sides of musical instruments (guitars, mandolins, etc); cabinetwork.

Supply.—Scarce.

Sizes.—Up to 40 centimeters or more in diameter, short and often crooked; rarely sawn, the material for shafts being generally split and that for musical instruments purchased by shops in short bolts, and sawn into veneer by hand as required.

Prices.—Shafts, roughed out and bent, sell at about ₱3.50 per pair in Manila; logs or bolts for musical instruments are generally acquired by barter, a guitar worth from ₱5 to ₱8 being exchanged for a log of 30 centimeters diameter by 3 meters length.

Genus HIBISCUS.

H. tiliaceus L. MALUBÁGO.

A small tree of the coasts, widely distributed; the heartwood is pale purplish brown, somewhat similar in appearance to lanutan, but much softer and lighter; used for fish-net floats, cheap scabbards, household implements, etc.

Genus THESPESIA.

T. populnea Corr. (Pl. V, fig. 38.) BANÁLO.

A small to medium sized tree found in central Luzon and Mindoro; the smooth, dark red heartwood is highly prized by musical instrument makers, but is very scarce in Manila.

BOMBACACEAE.

[Malabulak family.]

Genus BOMBAX.

B. malabaricum DC. MALABÚLAK.

A tree up to 75 centimeters or more in diameter; reported from: N. E., Bat., Riz., Lag., Min.; probably much more widely distributed.

Local names.—Búboi-gúbat (Riz., Min.); MALABÚLAK (Bat., Riz., Lag.).

Wood very light and soft; whitish when fresh cut and quickly seasoned, but turning grayish brown if seasoned in log; no distinct sapwood and heartwood; texture fairly smooth; grain even and straight; very easy to work. Durability very poor, but lasts well in sea water.

Structure.—Pith rays variable in thickness, not conspicuous; pores large, very scattered; soft tissue forming thin rings about pores and very numerous, faint, transverse bars between rays; growth rings absent or very faintly marked.

Uses.—Fish-net floats; light household implements.

Supply.—Scattered in dry regions, scarce.

Genus CEIBA.

C. pentandra Gaertn. KÁPOK.

A small to medium sized tree up to 45 centimeters in diameter; introduced from tropical America, but now found in probably almost every island and province; often planted for live fence posts and for the cotton contained in the pods.

Local names.—Búboi (Tag.); búlak, with various qualifying terms

(Tag., Pamp., Bis.); bosanglói (Abra); doldól or dondól (Bis., Il.); kápas-sanglái (Bont., Pang.); KÁPOK (Sulu and parts of Mindanao); káyo (Cam., Alb., Sor.); kúlak (Abra).

Wood very soft; very light, specific gravity 0.230 (Puigdulles); whitish, turning gray or light brown; no distinct heartwood; texture coarser and rougher than preceding.

Structure.—Pith rays fine, not conspicuous; pores large or very large, few, scattered, often with one or two transverse partitions; soft tissue as in preceding; growth rings, if present, ill defined.

Uses.—Fish-net floats; live fence posts and telegraph poles.

Supply.—Very widely distributed, but nowhere abundant.

Genus CUMINGIA.

C. philippinensis Vid. GAPAS-GÁPAS.

A tree of the mangrove swamps, up to 100 centimeters in diameter, but very rarely reaching such large size; reported from: Tay., Mas., Neg., Zambo., Bas., Pal., but probably found also in mangrove swamps of other regions.

Local names.—Balúno (Zambo.); buñgálon (Tay.); dandúlit (Zambo.); GAPAS-GÁPAS (Neg., Zambo.); libáto-putí', nígi-putí' (Tay.).

Wood soft to moderately hard; moderately heavy; no distinct sapwood and heartwood so far as known; pure creamy white, but liable to stain if seasoned in log; grain straight or slightly crossed; texture fine, smooth; seasons with little checking or warping; easy to work. Durability under severe exposure probably poor, but not attacked by beetles.

Structure.—Pith rays very fine, very numerous, indistinct; pores small, scattered singly or by twos and threes; soft tissue as in malabulak and kapok; growth rings only indicated by faint belts of lighter and darker shade; ripple marks present on all sections, especially conspicuous on tangential section.

Uses.—Planks and temporary construction; if sawn and seasoned carefully, would make an excellent substitute for lanete.

Supply.—Scarce.

Prices.—Not known to be marketed, except perhaps with cheap miscellaneous lumber.

STERCULIACEAE.

[Dungon family.]

A large family producing a number of woods of very widely varying character, ranging from very light and soft to very heavy and hard; pith rays generally numerous, of moderate thickness and evenly spaced, distinct to very conspicuous in radial section; pores few, scattered, often large, in many species surrounded by a very distinct ring of soft tissue of the same color and about the same width as the rays; soft tissue otherwise not generally conspicuous. Cacao, which belongs to this family, has a soft grayish wood similar to that of the genus *Sterculia.*

Genus HERITIERA.

One species, widely distributed, generally along inner edges of mangrove swamps, but also other coasts.

H. littoralis Dry. DUÑGON-LÁTE.

A tree up to 90 centimeters in diameter, with a rather short and generally irregular bole; reported from the following regions, but probably

even more widely distributed than the botanical collections indicate: Palaui, Cag., Pang., Zam., Bat., Tay., Cam., Sor., Min., Tic., Ley., Guim., Neg., Sur., Agus., Mis., Lan., Cota., Zambo., Bas., Cul., Pal.

Local names.—Bárit (Zambo.); bayag-kabáyo (Man.); dumón (Cag.); dúñgon and DÚÑGON-LÁTE, with about equal frequency (Zam., Bat., Tay., Cam., Sor., Min., Tic., Ley., Guim., Neg., Sur., Agus., Lan., Cota., Zambo., Bas., Pal.); magáyau (Cag.); malarúñgon (Tay.); palogápig, paloñgápoi, paronápin, paronápoi, etc. (Cag., Pang., Zam.).

The wood of dungon-late is practically indistinguishable from dungon and is put to all the same uses. (*See* dungon, p. 155.)

Genus PTEROCYMBIUM.

Two species, of which one (*P. macrocrater* Warb.) is reported only from a single collection, but taluto is very widely distributed and well known.

P. tinctorium Merr. (Pl. V, fig. 39.) TALÚTO.

A tall straight tree, up to 90 centimeters in diameter; reported from: Cag., N. E., Pamp., Zam., Bat., Riz., Lag., Tay., Cam., Min., Mar., Ley., Cebu, Neg., Sur., Cota., Zambo., Pal.

Local names.—Abigón (Bat.); bayaó (Sur.); bañgát (Zam.); duidúi (Tay.); huligano (N. E.); kulong-kulóng (Mar.); libtúk (Cag.); malasapsáp (Pamp.); talóto' or TALÚTO' (N. E., Bat., Lag., Tay., Cam., Min., Neg., Cota.? Pal.?); taóto' or taútu' (Bat.); tagungtúñgan (Cebu); takung (Sur.).

Wood very soft; very light; sapwood and heartwood indistinguishable, whitish, often staining to silvery gray in drying; grain perfectly straight; texture rather coarse in appearance, but not loose nor rough; very conspicuous silver gain; conspicuous ripple marks on tangential sections; seasons well, except for staining; extremely easy to work, but requires very sharp tools to make a smooth cut, especially across the grain. Durability very poor as regards decay, though not commonly attacked by insects.

Structure.—Pith rays large, distinct; pores large, scattered; soft tissue in very regular, smooth rings about pores; no growth rings.

Uses.—Floaters for rafting heavy logs; fish-net floats; cheap and temporary construction and box lumber; match and match-box veneer.

Supply and prices.—Nowhere abundant; rare in Manila market, being brought in only occasionally by large operators with cheapest grades of miscellaneous stuff, and in logs for match industry, for which manufacturers pay about ₱9 per cubic meter.

Genus PTEROSPERMUM.

A genus of about seven species, of which three are widely distributed and large enough to furnish saw timber. The wood of all species, as far as known, is practically identical in general appearance and structure, and the local names are applied very loosely to all; in the Manila market, if sold under its own name, best known as bayók or bayóg.

Local names.—Báloi and bároi (I. S., Abra, Pang., Tar.); BAYÓK, bayóg, or bayúk (N. E., Pamp., Zam., Bat., Riz., Lag., Batg., Tay., Cam., Cat., Min., Mas., Tic., Neg., Cota., Zambo., Pal.); bayog-bayóg (Zambo.); BAYOK-BAYÓKAN (Cam.); dibuál (Bas.); kalokatiñgan, kolokotiñgan, KULATIÑGAN, kulukutiñgan, etc., (Bont., Beng., Bul., Riz., Lag., Cam.); kantiñgan (Min.); pañgal-liñgáen (I. S.); pangliñgáen (N. E.); taliñgáan, (I. N.);

taliñgánan (Zam.); tamók (Bat.); taroñgatiñgan (Cam., Bur.); tiñgan-tiñgan (Tay.).

Wood moderately hard and rather tough; moderately heavy to heavy, specific gravity 0.685 to 0.717 (Puigdulles); sapwood somewhat paler than heartwood, not sharply distinguished from it; heartwood dull purplish brown, or reddish brown, fading on exposure to light brown; grain straight or slightly crossed; texture fine, smooth; distinct ripple marks on all longitudinal sections in most specimens; from color, texture, and presence of ripple marks easily mistaken for lanutan (*Bombycidendron* spp.); seasons well; easy to work. Durability IV, but rarely attacked by beetles.

Structure.—Pith rays numerous, crowded, fine; pores numerous, small to medium sized, scattered singly or in short radial lines; soft tissue inconspicuous; ripple marks very wavy; irregular narrow belts of dense tissue, sometimes discontinuous, sometimes branching.

Uses.—Posts (above stumps); beams, joists, rafters; flooring, sheathing, ceiling; furniture and cabinetwork; household implements; combs; impregnated would make good ties and paving blocks.

Supply and prices.—Limited; in Manila market rarely found except mixed with medium-grade miscellaneous lumber selling at about ₱50 per M. or upward. In provinces cut and used locally under its own name for interior work and furniture.

The following are the three best known species of *Pterospermum:*

P. diversifolium Bl. BAYÓK.

A tree up to 50 centimeters in diameter; reported from: I. S., N. V., N. E., Pang., Pamp., Zam., Riz., Lag., Batg., Tay., Cam., Min., Mas., Tic., Guim., Neg., Zambo., Bas., Pal.

P. niveum Vid. BAYOKBAYÓKAN.

A tree up to 60 centimeter in diameter; reported from: I. N., Abra., Lep., Beng., N. V., N. E., Pang., Tar., Pamp., Bat., Riz., Lag., Tay., Cam., Min., Agus., Mis., Cota.

P. obliquum Blco. KULATÍÑGAN.

A tree up to 70 centimeters in diameter; reported from: I. N., I. S., N. E., Lep., Beng., Un., Bat., Pamp., Bul., Riz., Lag., Tay., Bur., Sam., Guim., Zambo.

Genus STERCULIA.

A genus of about 17 species; medium sized to moderately large trees with generally a rather regular, fairly long bole. The wood of all species, as far as known, is of fairly uniform character and the local names are applied to all very loosely, except kalumpang, which is pretty constantly given to one species, *S. foetida.*

Local names.—Adupong (Beng.); balínad (Tic., Pal.); baníkad (Min.); BANÍLAD (Riz., Min., Guim.); bayayat (Isa.); bobó (Neg.); bobóg, boboy, bubóg, etc. (Min., Ilo., Bal., Pal.); bulakán (Lag.); bisong (N. V.); búñga (Tay.); buñgat (Cag.); kalang-giáuan (I. S.); kalukalumpáñgan (Riz.); KALUMPÁNG (N. E., Pamp., Bat., Riz., Man., Lag., Tay., Cam., Min., Ilo., Cota., Pal.); kalumpág (Riz.); kalupáng (Neg.); kandol-kandól (Min.); lontong (Zambo.); MAGULIPÁK, maguripák (Mas., Tic.); MALABÓHO' (Bat.); MALOBONOT (Bat., Riz., Man.); malabúñga (Tay.); malacacáo (Bat., Lag., Min.); malagasáha (Tay.); MALAKALUMPÁNG (Cam.); malapapáya (Bat.); malobo (Tay.); opong-ópong (Cam.); panakitin

(Min.); salimbubú (Min.); saripongpóng (Sor.); TAPINÁG (Bat.); úpak (Pamp.); uós or uóos (Cam.).

Wood soft to very soft; light to very light; sapwood scarcely if at all distinguishable from heartwood, fresh wood creamy white or very light gray or brown, but almost invariably staining to silvery gray or light brown; grain straight; texture coarse, spongy; except for staining, seasons well; very easy to work. Durability very poor; frequently attacked by beetles, though heartwood, if seasoned rapidly and thoroughly, is somewhat better than sapwood.

Structure.—Pith rays medium sized to thick, very distinct; pores few, medium sized, often partitioned, scattered; soft tissue inconspicuous, forming thin rings about pores and very numerous, extremely fine irregular cross lines, barely visible under a lens; growth rings marked by a very narrow, faint line.

Uses.—Cheap and temporary construction, box lumber, etc.; temporary mining timbers (Masbate); recommended for trial as match wood.

Supply and prices.—Rarely cut for lumber, except occasionally by larger operators with the cheapest grades of miscellaneous lumber, selling at about ₱40 per M.

The following are the largest and most widely distributed species of *Sterculia:*

S. blancoi Rolfe — MAGULIPÁK.

A tree up to 90 centimeters in diameter; reported from: N. E., Riz., Tay., Min., Mas., Tic., Bil., Mis.

S. crassiramea Merr. — TAPINÁG.

A tree up to 60 centimeters in diameter; reported from: N. E., Bul., Bat., Riz., Lag., Tay., Min.

S. cuneata R. Br. — MALABONÓT.

A tree up to 35 centimeters or more in diameter; reported from: Cag., Isa., Bont., N. E., Bul., Pamp., Bat., Riz., Man., Lag., Cam., Min., Sam., Agus., Mis., Bas., Cul., Pal.

S. foetida L. — KALUMPÁNG.

A tree up to 100 centimeters in diameter; reported from: Cag., Abra, N. V., N. E., Pang., Pamp., Bat., Riz., Man., Lag., Tay., Min., Ilo., Neg., Cota., Cul., Bal., Pal.

S. luzonica Warb. — MALAKALUMPÁNG.

A tree up to 60 centimeters in diameter; reported from: Isa., Man., Batg., Tay., Cam., Min., Mas., Tic., Rom., Tab., Guim., Neg., Bil., Zambo., Pal., Sulu Arch.

S. montana Merr. — MOUNTAIN TAPINÁG.

A tree up to 90 centimeters in diameter; reported from: Bab., Cag., N. V., Bat., Lag.

S. oblongata R. Br. — MALABÓHO.

A tree up to 70 centimeters in diameter; reported from: Batanes, I. N., Bat., Riz., Lag., Tay., Cam., Sor., Min., Ley.

S. philippinensis Merr. — BANÍLAD.

A tree up to 65 centimeters in diameter; reported from: N. E., Lag., Cam., Min., Sam., Guim.

Genus TARRIETIA.

A genus represented in the Philippines by three species, of which two are well known. The third, *T. riedeliana*, has been collected only once, in the Lanao District, and no wood specimen of it is known.

T. javanica Bl. (Pl. V, fig. 40.) LUMBAYÁO.

A tree up to 130 centimeters in diameter; reported from: Mis., Cota., Zambo., Bas.

Local names.—Gisang, LUMBAYÁO (Zambo., Bas.).

Wood moderately hard to hard; flexible and tough; moderately heavy to heavy; sapwood pale red, merging rather gradually into heartwood; heartwood light red to reddish brown, the average run from medium-sized trees about the color of cigar-box cedar; grain somewhat crossed; texture rather open, but taking a smooth and glossy surface under sharp tools; resembles very closely the Australian crowsfoot elm (*Tarrietia argyrodendron*), and superficially in texture and color Colombian mahogany (*Cariniana pyriformis*); seasons well, except for being somewhat liable to split at ends. Durability III; heartwood very rarely attacked by beetles.

Structure.—Pith rays moderately thick, distinct, forming a conspicuous though small silver grain in radial sections and visible as minute vertical dark lines in tangential section; pores few, moderately large to large, evenly scattered, sometimes with dark red glistening deposits; soft tissue in smooth thin rings about pores; no growth rings.

Uses.—Flooring; doors; interior finish; furniture and cabinetwork; boat ribs and planking; would probably make excellent slack cooperage stock; recommended for trial for steamed bent work.

Supply.—Though found only in such a limited region, there has been a fairly steady supply in the market for some years; could be obtained not in lots of many millions, but of hundred of thousands of feet.

Prices.—Sixty-five pesos to ₱100 per M.

A wood called LUMBAYÁO-BATÚ is cut occasionally in Zamboanga and Basilan, which has the structure of lumbayao, but is as dark colored, hard, and heavy as dungon. It is not known whether this is merely a very hard, dark variety of lumbayao, or the product of an as yet unknown species of *Tarrietia*.

T. sylvatica Merr. (Pl. VI, fig. 41.) DÚÑGON.

A tree up to 100 centimeters or more in diameter, with a generally short and often irregular bole; reported from: I. N., Cag., I. S., N. E., Pang., Tar., Zam., Bat., Pamp., Bul., Mar., Ant., Dav.; commercial material from several regions in Mindanao seems to be of the same species, but may in some cases be dungon-late.

Local names.—DÚÑGON (N. E., Zam., Pamp., Bat. Bul., Riz., Lag., Batg., Tay., Cam., Alb., Min., Mas., Mar., Ant., Dav.); duñgúl (Cag.); palogápig (I. N., Tar.); palonápoi, paronápoi (Pang.); paronápin (Cag., I. S., Pang., Zam.).

Dungon and dungon-late are practically indistinguishable. Dungon-late has generally a larger proportion of sapwood and the sapwood seems to merge into the heartwood more gradually than in dungon; also dungon-late is perhaps slightly lighter in color and seems to have fewer chalky deposits in the pores, and stony deposits in knots and heart cracks; but the only way of distinguishing commercial material is to ascertain its origin, dungon-late being a tree of the swamps and coasts and dungon of the dry hill forests.

In mechanical properties dungon-late is probably as good as dungon and, excepting the greater amount of sapwood, there is no evidence to show that it is not equally durable.

Wood very hard; very tough and flexible, but not resilient; heavy, specific gravity 0.852 (Foxworthy); sapwood of dungon 2 to 4 centimeters thick, of dungon-late up to 6 or 8 centimeters, pale reddish brown, in mature trees sharply marked off from heartwood; heartwood reddish brown to dark chocolate; often containing large masses of stony deposits in old knots and heart cracks; peculiar odor resembling that of old leather; grain crossed and sometimes curly; texture fine, dense, smooth, but not glossy; logs and large timbers liable to split deeply in seasoning; boards less liable to split, but must be piled carefully and heavily loaded to prevent warping; very difficult to work, both on account of its hardness and toughness, and because it dulls tools badly, even when no stony deposits are met. Durability I; heartwood rarely attacked even by termites and only eaten very slowly by teredo; sapwood rapidly attacked by both insects and fungi.

Structure.—Pith rays moderately thick, distinct; pores medium sized, scattered singly, or crowded in very short, radial rows, frequently with dark reddish and sometimes with chalky deposits; soft tissue in thin, distinct rings about pores and forming network of extremely fine, faint lines between rays; growth rings irregular and indistinct, not marked by any definite boundary.

Uses.—Piling; posts; foundation sills; ties, paving blocks; bridge, wharf, and ship building; beams, joists, rafters; hubs, spokes, felloes, and axles; capstan bars and other levers; ax, pick, and other tool handles; mallets and other wooden tools; recommended for steamed bent work where strength and durability are required.

Supply.—Scarce, but almost always a small stock on hand in Manila yards, generally in logs to be sawn to order.

Prices.—One hundred and fifty pesos to ₱220 per M.

DILLENIACEAE.

[Catmon family.]

A family containing but one genus of timber trees of any importance.

Genus DILLENIA.

About 15 species of trees ranging from 30 centimeters to 70 centimeters or more in diameter; one or more species reported from almost every island and province in the Archipelago. Excepting a wide range of color, from light brick red to very dark reddish brown, the wood of all species is practically identical in general appearance as well as in structure, and is known in the Manila market as catmon. The local names are very loosely applied to all species and are here given for the whole genus.

Local names.—The commonest are: CATMÓN and compounds of it, such as MALACATMÓN, kalokatmón, CATMÓN-CALABÁU, etc. (C. and S. Luz., Min., Mas., and C. Bisaya Islands); and paláli, pamalalíen, magálapaláli, etc. (N. and N. C. Luz.); others, less widely used, alato (N. Luz.); anagáu (Sur.); atpúi (Pal.); biskan (Beng.); diñgin (Zam.); kotmó' or kotmók (Cam., Alb., Sor.); malaigáng (Zambo.); malaliring (Bat.); magatlí (Cag.).

Wood hard; heavy, specific gravity 0.705 (Foxworthy) to 0.816 (Puigdulles); sapwood pale red, not sharply marked off from heartwood; heart-

wood light brick red to dark reddish brown; pith rays on radial section extremely conspicuous, forming an evenly distributed, but most capricious pattern of dark curls and waves; grain sometimes fairly straight, but generally very curly and twisted, hence difficult to split; texture rather coarse in appearance, but dense; colors water pale red; seasons well, checking and warping very little; difficult to saw but otherwise fairly easy to work. Durability II; not attacked by beetles.

Structure.—Pith rays numerous, distinctly of two classes, thick to very thick and very fine, generally very wavy; thick rays very conspicuous, sometimes branching, in transverse section lighter, in longitudinal sections darker than wood; thin rays sometimes almost invisible even under hand lens; pores small to medium, widely scattered, often completely filled with chalky deposits; soft tissue inconspicuous, in extremely thin rings about pores and transverse lines between rays; no growth rings.

Uses.—Posts above stumps; beams, joists, rafters; flooring; sheathing and ceiling; furniture and cabinetwork; musical instruments; paving blocks and mine timbers (impregnated). A wood that, on account of its unusual flake grain, should be much more used for cabinetwork and would make a most beautiful veneer.

Supply.—Scarce in Manila market, though widely distributed and used locally wherever it occurs.

Prices.—One hundred pesos to ₱120 per M.

The following are the best known species of *Dillenia:*

D. luzoniensis Merr. MALACATMÓN.

Reported from: N. V., Pang., Zam., Bat., Pal.

D. philippinensis Rolfe (Pl. VI, fig. 42.) CATMÓN.

Reported from: Bab., Cag., Beng., N. E., Pang., Bul., Pamp., Bat., Riz., Lag., Batg., Tay., Pol., Cam., Alb., Sor., Min., Mas., Sam., Ley., Neg., Cebu, Guim., Agus., Mis., Lan., Dav., Cota., Zambo., Bas.

D. reifferschiedia F.-Vill. CATMÓN-CALABÁU.

Reported from: Riz., Lag., Tay., Cam., Alb., Sor., Min., Occ. Neg., Zambo.

GUTTIFERAE

[Mangosteen family.]

A large family, but containing only one very well-known timber tree, bitaog or palomaria. Most of the woods of this family are hard and heavy; they vary in color from light yellow to deep reddish brown; in their structure they have one common feature, the numerous fine to broad, more or less regularly concentric lines of soft tissue.

Genus CALOPHYLLUM.

A genus of nearly 20 species in the Philippines, of which only four are known to be large enough and of sufficiently wide distribution to be of any importance. Though varying considerably in color, hardness, weight, and texture, the structure is very similar in all species.

The Spanish name palomaria, or palomaria de la playa ("of the beach") is given to bitaog (*C. inophyllum*) wherever there have been lumbering operations of any kind and around coast towns and villages; all the other species, which are found only in the interior (or on hills near the coast) are known as palomaria del monte and bitanhól.

C. blancoi Pl. & Tr. BITANHÓL.

A tree up to 60 centimeters in diameter, tall and straight; reported from: I. S., Cag., Bont., Beng., N. E., Zam., Bat., Riz., Lag., Tay., Cam., Sor., Ambil, Mas., Sur., Lan., Zambo., Pal.

Local names.—BITANHÓL or bitang̃ól (N. E., Lag., Cam., Alb., Sor., Mas., Ley., Cap.); bitáog (Lag.); bitáoi-bákil (Pang.); bitáong (Sur.); pamikláten and pamitlaten (I. S.); palúmut (Pal.); pamitáogen (I. S.); pamitaóien (Pang.); tadók (Cag.).

Wood moderately hard; moderately heavy, specific gravity 0.723 (Puigdulles), 0.621 (Foxworthy); sapwood small, pale red, rather sharply distinguished from heartwood; heartwood light red to reddish brown; grain distinctly crossed; texture fine, glossy; rather tough and difficult to split; seasons very well; easy to work, except for difficulty of surfacing cross grain in radial sections. Durability III, but heartwood rarely attacked by insects.

Structure.—Pith rays fine, rather indistinct; pores medium sized, in irregular, wavy, and branching radial lines, often with pale sulphur yellow deposits; soft tissue in thin rings about pores and forming a loose, irregular network of broken, wavy, concentric lines; no growth rings.

Uses.—Masts and spars; bridge, ship, and boat building; carriages and other vehicles (frames or beds); posts, beams, joists, rafters; flooring; furniture and cabinetwork; hubs; shafts; a wood which, for its beauty of grain and color, deserves more attention from cabinetmakers.

Supply.—Scarce in Manila market.

Prices.—About ₱100 per M. when sold under its own name; sometimes ignorantly or fraudulently substituted for bitaog (palomaria), but more frequently mixed with miscellaneous lots.

C. cumingii Pl. & Tr. MARABITÁOG.

A tree up to 40 centimeters in diameter; reported from: Cag., Un., Pang., Zam., Min., Tic., Neg., Guim., Cul., Pal.

Local names.—Bantaógan (Min.); bitáoi-bákil, bitók-gúbat (Zam.); bitang̃ól (Tic.); MARABITÁOG (Un.); pamiltáogen (Zam.); pamittaógen (Cag.).

Wood practically identical with preceding.

C. inophyllum L. (Pl. VI, fig. 43.) BITÁOG or PALOMARIA DE LA PLAYA.

A tree up to 130 centimeters in diameter, but generally with a very short and irregular bole; reported from practically every province having any seacoast; common and very well known, but nowhere abundant.

Local names.—Batárau (Palaui); BITÁOG (Bab., I. N., I. S., Un., Zam., Bat.); bittáog (Cag., Isa.); bitáoi (Pang.); dagkálan (Isa.); dangkálan (Cam., Alb., Sor., Min., Mas., Neg., Agus., Lan., Bas., Pal.); pamitaógen (Palaui); vutálau (Bats.); palomaria, or palomaria de la playa (Span.).

Wood harder, heavier and usually darker than bitanhol; grain generally very curly, wavy, and crossed, making wood very hard to split and also difficult to surface; seasons well; except difficulty of surfacing, not hard to work. Durability II; very rarely attacked by insects.

Structure.—Very similar to bitanhol.

Uses.—Posts or stumps; doors; flooring; sheathing and ceiling; ship knees and ribs; hubs; fine furniture and cabinetwork; musical instruments (necks and heads).

Supply and prices.—Scarce in the lumber market, where it brings from ₱125 to ₱170 per M. Cart and other vehicle builders in Manila and the interior pay proportionately much higher prices for small logs for hubs,

as high as ₱2.50 being paid for bolts 30 centimeters in diameter and 50 centimeters long, or just enough for a pair of cart hubs.

C. whitfordii Merr. PAMITAÓGEN.

A tree up to 55 centimeters in diameter; reported from: Cag., N. E., Pang., Bul., Zam., Bat., Lag., Tay., Cam., Min., Ley., Agus., Camiging, Lan.

Local names.—Bitamók (Min.); bitañgól (Bul., Tay.); bitáog (Zam.). PAMITAÓGEN (Cag.).

Wood identical with bitanhol.

Genus CRATOXYLON.

A genus of small to medium sized trees, containing about five species, the wood of all of which is practically identical in mechanical properties, color, and structure.

Wood moderately hard; moderately heavy; sapwood 2 to 5 centimeters thick, merging gradually into and hardly distinguishable from heartwood; heartwood pale pinkish or reddish brown, darkening gradually in heart of large trees; grain straight; quarter-sawn face with narrow ribbon of lighter and darker color and very fine silver grain; flat-sawn face with a small, very pretty, "watered-silk" grain; texture fine, dense, smooth; seasons well; fairly easy to work. Durability III; not attacked by beetles.

Structure.—Pith rays numerous, fine, distinct; pores small, in irregular, crooked radial lines; soft tissue forming ill-defined patches about groups of pores and numerous (6 to 10 to the millimeter of radius) wavy and branching, concentric lines, which cause the "watered-silk" effect in tangential sections; no growth rings.

Uses.—Used locally for posts, beams, agricultural implements, etc.; a favorite fuel and charcoal wood, whence the names containing the word *úling* or *úring* (charcoal); if impregnated, would make good ties and paving blocks.

Supply and prices.—Rarely if ever brought to Manila market except mixed with miscellaneous lumber.

Three species are widely distributed and the local names seem to be applied to them indifferently; they are here given for the genus without distinction of species:

Local names.—Alibágon, aligógon (Riz.); bansilai (Bat.); bansilaían (Din.); baringkukúrung (I. N., I. S., Cag., Abra); bíro (Cag.); gansilai (Bas.); GUYUNG-GÚYUNG (Pang., Bat., Bul., Riz., Tay., Cam., Min.); kansilai (Min., Neg.); kulis (N. E.); kuttú (Cag.); pagulíñgin (Riz.); pagulíñgon (Neg.); PAGURÍÑGON (Cam., Alb., Mas.); panagulíñgon (Zam.); SALINGGÓGON (Cam., Alb.); úging, ugíñgen (Cag.); úling (Abra); uliñgon (Sur., Agus.); uríñgon (Mas.).

C. blancoi Bl. (Pl. VI, fig. 44.)[1] GUYUNG-GÚYUNG.

A tree up to 60 centimeters in diameter; reported from: I. N., I. S., Abra, N. E., Pang., Zam., Bat., Bul., Batg., Riz., Lag., Cam., Alb., Min., Mas., Sam., Ley., Neg., Din., Bas., Pal.

C. celebicum Bl. PAGURÍÑGON.

A tree up to 80 centimeters in diameter; reported from: Cag., Abra, Beng., N. E., Tar., Pang., Bul., Zam., Bat., Riz., Lag., Tay., Alb., Min., Mas., Ley., Agus., Sur., Cota.

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[1] This figure is from a specimen without specific determination; the structure of all species of the genus is practically identical.

C. formosum Dyer SALINGGÓGON.

A tree up to 55 centimeters in diameter; reported from: Cag., Zam., Bul., Batg., Riz., Lag., Tay., Cam., Sor., Sam., Guim., Cul., Agus., Zambo., Pal.

Genus GARCINIA.

A genus of small to medium-sized trees of about 30 species. Only a few commonly reach over 30 centimeters in diameter. The different species are not yet all well known, and it is impossible to state which ones have yellow wood and which dark red; it is possible that most or all species will have red heartwood when old.

The local names are very loosely applied to different species and are here given for the whole genus:

Local names.—Alukó' (Isa.); balukúk (Beng.); baukók (Zam.); BASÁN (Min.); batúan (Bur., Neg., Guim.); bilis (Beng.); bitañgól (Sib.); bugalót (Sib.); bunég, BUNÓG, or bunúg (I. N., I. S., Cag., Pang., Pal.); buragrís (Cam.); bilúkau or BINÚKAU (Bat., Batg., Riz., Lag., Cam.); dangkálan (Cam.); GATÁSAN (Lag., Tay., Cam., Pal.); hagumunán (Cam.); háras (Cap.); kamandíis (Min.); kamantíis (Sor.); kandíis (Zambo., Pal.); katápang (Agus.); katúri (Cag., Isa.); kulilem (Cag.); MALABUNÓG (Cag.); manggala (Zambo.); maninilá (Cam.); pédis (Pamp.); péris, PÍRIS (Cav., Batg., Riz.); píldis (Pamp.); puláñgi (Sam.); súsung-karabáu (Min.); TAKLÁNG-ANÁK (Pamp., Bat., Lag., Min.).

Wood hard; heavy to very heavy; sapwood very variable in thickness (some trees up to 30 centimeters or more in diameter show no distinct heart), yellow, sometimes merging gradually into heartwood, sometimes quite sharply distinguished from it; heartwood, when distinct, deep reddish brown; grain straight; texture fine, dense, glossy; seasons without warping much, but liable to split; hard to saw, but not otherwise difficult to work. Durability II at least; especially the red varieties have an excellent reputation for posts; not attacked by beetles.

Structure.—Pith rays fine, distinct; pores small to medium sized, scattered singly or in radial rows of 3 or 4; soft tissue in red specimens in small, indistinct patches about pores, and very numerous, thin, wavy and much interrupted concentric lines; in yellow specimens, concentric lines much broader (generally just about as broad as intervening belts of hard tissue) and less broken; scanty whitish deposits in pith rays and pores; no growth rings.

Uses.—Poles, posts, ties, paving blocks; beams, joists, rafters; flooring; piling.

Supply and prices.—Rare in Manila market except in miscellaneous lumber, so has no fixed market price, but much used locally, wherever available, for house construction.

The following are the largest and best known species of *Garcinia*.

G. benthami Pierre BUNÓG.

A tree up to 40 centimeters in diameter; reported from Palawan only; wood apparently always dark red.

G. binucao Choisy BINÚKAU.

A tree up to 50 centimeters in diameter; reported form: I. N., Cag., Beng., Zam., Bat., Batg., Riz., Lag., Tay., Cam., Alb., Bur., Neg., Cap., Guim., Pal. Wood yellow or reddish.

G. cumingiana Pierre MALABUNÓG.

A tree up to 50 centimeters in diameter; reported only from Cagayan and Bontoc. Wood reddish.

G. dulcis Kurz TAKLÁNG-ANÁK.

A tree up to 60 centimeters in diameter; reported from: I. S., Cag., Isa., Pang., Zam., Bat., Riz., Cam., Mas., Neg., Zambo., Pal. Wood, as far as known, always yellow.

G. eugeniaefolia Wall. BASÁN.

A tree up to 60 centimeters in diameter; reported from: Tay., Min., Sib., Ley., Cebu, Pal. Wood, as far as known, always yellow.

G. venulosa Choisy GATÁSAN.

A tree up to 40 centimeters in diameter; reported from: Cag., Isa., N. V., Pang., Pamp., Bul., Bat., Cav., Batg., Lag., Tay., Cam., Min., Zambo., Pal. Wood generally yellow, some specimens red.

G. vidalii Merr. PÍRIS.

A tree up to 90 centimeters in diameter; reported from: Beng., Pang., Riz., Lag., Sam., Agus. Wood, as far as known, always yellow.

Genus KAYEA.

A genus of small to medium sized trees of about six species. The wood of all species appears to be practically identical in mechanical properties, color, and structure. Only one species, *K. paniculata*, appears to be widely distributed.

K. paniculata Merr. KALÍWAS.

A tree up to 50 centimeters in diameter; reported from: Isa., Bat., Tay., Cam., Min., Agus.

Local names.—Bagatal, gitakí, kadang-ísol (Cam.); KALÍWAS or karíwas (Bat.); kátong-bakúlau (Bat.); kíting-kíting (Bat.); liúsin-pulá' (Bat.); palomaría or palomaríang-babáe (Tay., Min.).

Wood soft to moderately hard; moderately heavy; sapwood and heartwood scarcely distinguishable; light grayish to pinkish brown; grain straight; texture very fine and smooth, showing in tangential sections a "watered-silk" grain and in radial sections very narrow lighter and darker lines and a minute silver grain; general appearance of radial section very similar to California redwood; seasons well; easy to work. Durability not well known, but wood stains badly when seasoned in log, so probably not durable when exposed; rarely attacked by beetles.

Structure.—Pith rays very fine, indistinct; pores numerous, small or very small, evenly scattered; soft tissue forming numerous, conspicuous, fine, wavy, very even and continuous concentric lines about 1 to 1.5 millimeters apart; no growth rings.

Uses, supply, and prices.—Local uses little known; does not come into market alone, but only with miscellaneous lumber; would make a very pretty and easily worked interior finish and cabinet wood and, impregnated, good ties and paving blocks.

A wood called tandú has recently been cut in considerable quantities for ties in the Sulu Archipelago, but the railway companies have refused to accept it and the ties brought to Manila are cut up for minor interior finish and for furniture. Tandu very probably belongs to this genus and may be identical with kalíwas, but is more probably of some other species.

DIPTEROCARPACEAE.

[Lauan family.]

This is by far the most important family in the Philippines, about three-fourths of the standing timber belonging to it. The trees are almost without exception tall and straight, range from 30 centimeters to over 200 centimeters in diameter, and their woods are everywhere utilized for a wider range of uses than those of any other family.

While there is a very wide range of weight, hardness, color, and mechanical properties, as well as durability, there are certain features of structure that are fairly uniform throughout the whole family, from the softest of the lauans to the hardest of the yacals. The majority are either slightly or very conspicuously cross-grained. Growth rings are rare, except in the first years of growth, where they are sometimes present, though not sharply defined. Ripple marks are still rarer and, when present, rather indistinct. The most characteristic feature of the family is the presence of numerous resin ducts, partly scattered, but more often arranged in conspicuous narrow concentric lines, giving the appearance of growth rings. That they are not growth rings is shown by their very irregular spacing and, what is more conclusive, by the fact that they rarely form complete circles. The presence of distinct resin rings proves that a specimen belongs to this family, but they are so irregularly arranged that a small specimen may often be without them. The pith rays are fine to moderately thick, not always conspicuous, but generally distinctly to be seen with the naked eye. Pores very variable in size, scattered, or in some woods arranged in rough net-like or herringbone patterns. Soft tissue very variable, never in regular, conspicuous concentric lines.

Genus ANISOPTERA.

A genus of five known species in the Philippines. The wood of all species is practically identical in structure and general appearance and is known as palosapis in the markets.

Wood moderately heavy to heavy, specific gravity 0.399 (Gardner)[1] to about 0.590; sapwood large (6 to 12 centimeters) whitish, but very commonly staining to dirty gray or brown in drying, rather sharply marked off from heartwood; heartwood yellowish with rose-colored streaks and blotches or evenly rose colored; when taken wet from saw and exposed to air and sunlight, the whole surface often turns to an even, intense rose red within an hour or less, but fades out again later; when seasoned, the color is pale yellow with reddish or light yellowish brown markings; slight disagreeable odor when fresh; grain somewhat crossed; texture rather coarse, but fairly dense; does not check much, but is liable to warp if not carefully seasoned; easy to work. Durability III when exposed to weather, but poor in ground; very rarely attacked by beetles, but sapwood much inferior to heartwood in this respect.

Structure.—Pith rays numerous, very fine and moderately thick to thick, the latter very conspicuous; pores medium to large, numerous, very evenly scattered; resin canals few, rarely forming rings, widely and irregularly

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[1] It should be remarked that Gardner's test material was from comparatively small trees from a lowland region; the lumber from the large trees of the Bataan mountains was not then available. A recent test of material of this class thoroughly air dry gives a weight of 0.678, which, deducting an estimated moisture content of 15%, would be equivalent to 0.589 for dry wood.

scattered, resin content almost white; soft tissue inconspicuous, forming minute dots and lines between rays; growth rings very indistinct or absent.

Uses.—Posts above stumps; beams, joists, rafters; floors; doors; sheathing and ceiling; wagon beds; furniture; dugout canoes, boats, barges; rice mortars; backs and bases of harps and smaller musical instruments; dashboards and other parts of carretelas and carromatas; all cheap or temporary construction; boxes and packing cases.

The best grades of palosapis are often ignorantly or fraudulently sold and used as mangachapuy, to which wood it is not quite equal.

Supply.—Widely distributed, but usually not abundant.

Prices.—Fifty pesos and upward per M.

The following are the known species of *Anisoptera:*

A. brunnea Foxw. AFÚ.

A tree up to 100 centimeters or more in diameter; reported from: I. N., Cag., only with above name.

A. curtisii Dyer DÁGANG.

A tree up to 90 centimeters or more in diameter; reported from: N. E., Pang., Lag., Cam., Pol., Neg.

Local names.—Bálau (Neg.); DÁGANG (Lag., Cam.); malagáñgau, malapáho' (Cam.); manápo (Pol.); palosápis (Pang., N. E.).

A. thurifera Bl. (Pl. VI, fig. 45.) PALOSÁPIS.

A tall, straight tree up to 200 centimeters in diameter; reported from: I. N., Cag., I. S., Abra, N. V., N. E., Pang., Bul., Zam., Bat., Riz., Lag., Tay., Cam., Alb., Min., Mas., Tic., Sib., Cap., Neg.

Local names.—Apnít (Abra); bariwiswís (Pang.); dágang (Bul., Riz., Alb.); dagum (Lag.); dúyung or dúung (I. N., I. S., Abra); gúyong (I. N.); lauán (Riz.); létis (Ilo., Tic., Occ. Neg.); mayápis (N. E., Zam., Bat., Bul., Riz., Min.); PALOSÁPIS (N. E., Tar., Pang., Zam., Bat., Tay.); paihápi (Zam.); sinalígan (I. S.); tabilá (Cam.); tulus (Riz.).

A. sp.

A tree up to 100 centimeters or more in diameter; reported only from Zambo., no local name recorded. Small quantities of palosapis are found among miscellaneous lumber of the Zamboanga mills.

Genus DIPTEROCARPUS.

A genus of about 15 species in the Philippines, one or more reported from practically every island and province. The trees are tall and straight and in the best situations reach 180 centimeters or more in diameter.

The wood of all species is practically identical as far as structure goes; in weight, hardness, and color the differences between various species seem to be no greater than those found within individuals of the same species growing in different regions. All are classified as apitong in commerce.

Wood moderately hard to hard, stiff and strong, moderately heavy to heavy, specific gravity 0.620 (Foxworthy), 0.587 to 0.645 (Gardner); sapwood 2 to 6 or 8 centimeters thick, when fresh grayish or brownish, sometimes staining badly in seasoning, not quite sharply marked off from heartwood; heartwood light ashy red to reddish brown or dark brown; grain generally fairly straight or slightly crossed, often forming very regular diagonal waves on the face of a plank; texture rather coarse and rough; odor of resin when fresh, noticeable even in old dry pieces when

worked over; resin exudes from ends of logs and old pieces when cut and exposed to sun (by which it can be distinguished from guijo); does not check badly, but is liable to warp if not seasoned carefully; harder to saw than the less resinous woods of its family, but not otherwise difficult to work. Durability III; not commonly attacked by beetles, but occasionally by dry rot.

Structure.—Pith rays generally distinctly of two kinds, fine and moderately thick, 1 to 4 or 5 thin ones between every two thick ones; pores small to medium, oval, rarely partitioned, numerous, evenly scattered, often with whitish resin deposits; resin canals sometimes very few or almost absent, sometimes very numerous, scattered or forming many and conspicuous incomplete rings; soft tissue very variable, in rather thin rings or in small irregular patches about pores and numerous, scattered, broken, ill-defined crosslines between rays; no growth rings. (Plate VI, fig. 46.)

Uses.—Posts above stumps; beams, joists, rafters; flooring; bridge and wharf construction (except piles); wagon beds; ship planking, barges and lighters; ties, paving blocks, mine timbers (impregnated); cheap and medium grade furniture; one of the most generally used construction woods in the Islands.

Supply.—One of the most widely distributed and abundant woods in the Archipelago.

Prices.—Thirty-five pesos to ₱90 per M.; the average during the last five years has been between ₱60 and ₱70.

The following are the best known species of *Dipterocarpus:*

D. affinis Brand.

Reported from: Cag., Tay., Cam., Min., Sur., Agus., Zambo.

Local names.—Anaháuon (Cam.); bálau, báyu (Sur.); hagakhák (Tay., Min.); kamúyau (Cag.); lipús, lipút, lipúut (Sur.).

D. grandiflorus Blco. (Pl. VI, fig. 46.) APÍTONG.

Reported from: Cag., Palaui, I. S., Abra, Isa., Beng., Pang., N. E., Zam., Bat., Bul., Riz., Lag., Tay., Cam., Alb., Sam., Min., Neg., Cap., Sib., Agus.

Local names.—Anaháuon (Cam.); APÍTONG (Zam., Bat., Pang., Bul., Lag., Tay., Cam., Alb., Min., Sam., Occ. Neg.); bálau (Cam., Cap., Occ. Neg., Sib., Agus.); danlóg (Cap.); dauen or duen (Cag.); hagakhák (Cam., Sib.); himpagkatán (Sam.); kamúyau (Palaui); lítis (Cap.); pagsahí-n͠gin or palsaín͠gin (Lag.) pamalalíen, pamarnísen (Cag.); pamantúlen (Pang.); pánau (Zam., Bat.).

D. hasseltii Bl.

Reported only from N. E., Lag. and Zambo.

Local names.—Pagsahín͠gin (Lag.); pánau (N. E.).

D. pilosus Roxb. HAGACHÁC.

Reported from: Cag., N. E., Riz., Tay., Cam., Pol., Min., Mar., Sam., Ley., Agus., Dav., Zambo., Bas.

Local names.—Anaháuon (Cam.); apítong (N. E.); bálau (Agus.); hagakhák or HAGACHÁC (Tay., Cam., Pol., Min., Mar., Sam., Ley., Neg.): kamúyau (Cag.); pamalalíen (Cag.); pánau (Tay.).

D. speciosus Brand.

Reported from: Cag., Isa., Tay., Cam., Alb., Occ. Neg., Bas.

Local names.—Anaháuon (Cam.); apítong (Alb., Occ. N.); hagakhák (Tay.); panalsálan (Cam.).

D. vernicifluus Blco. PÁNAO.

Reported from: Cag., I. N., I. S., Isa., N. E., Pang., Bul., Pamp., Zam., Bat., Riz., Lag., Tay., Cam., Pol., Min., Mar., Ley., Occ. Neg., Sur., Dav., Cota., Zambo., Pal.

Local names.—Afú (I. N.); apítong (Bat., Lag., Min., Ley.); bálau (Zam.); duho (Isa.); gan'án (Cam.); kalusúban (I. S.); kamúyau, karunyáu, kurimau (Cag.); lamílan (Isa.); lauáan (N. E., Riz.); lipús (Sur.); malapáhó (Pol.); pálau (Riz., Zambo.); pamalalíen (Cag.); pamantúling (Pang.); PÁNAO (N. E., Pang., Pamp., Zam., Bat., Bul., Riz., Lag., Tay., Pal.); pagsahíngin, palsahíngin (Lag.); patsahíngin (Pol.); sitan or zitan (Cag.).

Genus DRYOBALANOPS.

No botanical collections of any species of this genus are reported, but a strongly camphor-scented wood with the local name kapor has been cut in Manukmanka Island, Sulu Archipelago; it agrees in odor, general appearance and structure with specimens of kapor or borneo camphorwood (*Drybolanops aromatica* Gaertn. f.). In color, texture and mechanical properties kapor resembles apitong (*Dipterocarpus* spp.), but is superior to it on account of its greater durability.

Genus HOPEA.

A genus of 10 or more species, tall, straight trees, 100 to 180 centimeters in diameter, except gisok-gisok, which barely reaches 50 centimeters. The woods of this genus are moderately hard to very hard, moderately heavy to very heavy, pale yellow to light brown darkening very rapidly on exposure, straight or cross-grained, of fine to very fine texture, strong, tough and moderately durable to very durable.

The woods of the genus *Hopea* fall into two groups known, from the names of the best known species of each group, as the yacals and the mangachapuys; the yacals are harder, heavier, stronger, darker (when fresh) and more cross-grained than the mangachapuys; they are also much more durable. Yacal (including under this, as a commercial name, the several species of *Shorea* and of *Vatica* which furnish almost identical woods) is by far the most abundant of the very hard, strong, and durable high-class construction timbers of the Islands.

Following are the species belonging to the yacal section of the genus *Hopea;* the names of provinces cited after the local names of the trees cover practically the whole distribution of each species.

H. basilanica Foxw.

Local names.—Dalingdingan, pánau, yakal (Bas.).

H. philippinensis Dyer GISOK-GÍSOK.

Local names.—Gisok (Neg., Agus.); GISOK-GÍSOK (Ley., Neg., Zambo.); makitarim, manggatarím, and similar forms (Pang., Tay.); malabató (Agus.); malalamba, malatagúm (Alb.); pagaksón (Cam.); painá' (Tay.); pungó' (Sam.); taming-táming (Zambo.); yakál (Lag.).

H. plagata Vid. YACÁL.

Local names.—Banútan (I. N., I. S., N. E.); bátik (I. S.); dalingdíngan (Bas.); gisok-gísok (Sor.); háras (Tab.); kalíót (Ilk., Pang.); malíúm (Min.); paniggáian (Ilk.); quiébra-hácha (Zambo.); sallapugúd (Ilk.); sarabsában (Min.); saplúngan (N. E., Bul., Riz.); siakál (Zam., Bat.);

siggái, with various adjectives (I. N., I. S., Zam.); taggái (Cag.); YACÁL, with various adjectives (N. E., Bul., Pang., Zam., Bat., Riz., Tay., Cota., Zambo.).

With the exception of *H. philippinensis*, which is a small to medium-sized tree, all of these and probably some other species not yet botanically known (together with *Shorea* spp.), furnish commercial yacal in large quantities.

Wood hard to very hard; tough, but very stiff; heavy, specific gravity 0.830 (Foxworthy), 0.834 (Gardner); sapwood 2 to 8 centimeters thick, pale yellow when fresh, often staining to a dirty gray, rather sharply distinguished from heartwood; heartwood pale yellow to light yellowish brown, darkening rapidly on exposure; sometimes with narrow, irregular greenish streaks which in drying turn greenish black; texture fine and dense, with a translucent look like yellow horn, and a shiny surface when cut across the grain with a sharp knife; grain generally sharply crossed, making wood difficult to split radially and showing a marked ribbon when surfaced; slight sour odor; does not check badly, but warps considerably if not carefully seasoned; difficult to work, but saws with a very clean surface. Durability I, except as regards teredo.

Structure.—Pith rays fine, numerous, uniform; pores small to medium, evenly scattered; resin rings frequent; soft tissue forming thin rings or small, irregular patches about pores and fine, irregular crosslines between rays; no growth rings. The structure somewhat resembles that of gisok (*Shorea balangeran*). (*See* Pl. VII, fig. 49.)

Uses.—All high-grade permanent construction except salt water piling; posts, beams, joists, rafters; bridges, wharfs, ship framing and decks; flooring; hubs, spokes, felloes, axles, poles, single and double trees, etc.; ax, peavy and cant-hook handles, capstan bars, levers of all kinds; tool handles; cabinetwork; railroad ties; paving blocks.

Supply.—Abundant.

Prices.—Sixty pesos to ₱120 per M.

The following are the best-known species of the mangachapuy group of the genus *Hopea:*

H. acuminata Merr. (Pl. VI, fig. 47.) MANGACHAPÚY.

Local names.—Bañgóran (Sam.); baniakáu (Cag.); barosingsíng (I. N.); dalingdíñgan (Cag., Bul., Bat., Lag., Tay., Ley.); kaliót (N. V., Un., Tar., Pang.); manggachapúi or MANGACHAPÚY (Lag., Tay., Cam., Alb., Sor., Mis., Dav.); manggasinóro (Min.); siyaú (Sam.); yakál (Tay.).

H. foxworthyi Elm.

Local names.—Manggachapúi (Rom., Sib., Zambo.); yakál (Alb., Zambo.).

H. pierrei Hance DALINGDÍÑGAN-ISÁK.

Local names.—Dagingdíñgan or DALINGDÍÑGAN (Zam., Lag., Tay., Pol., Cam., Occ. Neg.); dala (Cag.); isák (Tay.); kaliót (Pang.); lito' (Cag.); malatagúm (Alb., Sor.); manggachapúi (Pang., Sor.); písak (Cag.); salabsálab, sarabsarában (Min.); sugkád (Sam.); also from Lanao, without local name.

Wood moderately heavy to heavy, specific gravity 0.726 (Foxworthy), 0.590 to 0.725 (Gardner), but wood of *H. foxworthyi* is probably heavier than any material heretofore tested; moderately hard to hard; sapwood 4 to 8 centimeters thick, lighter in color than heartwood, both fresh and

seasoned; heartwood pale straw color turning rapidly to clear brown on exposure, often with irregular, narrow streaks, which are grass green when just from the saw, but turn to dark greenish brown or nearly black; *H. foxworthyi* has the most conspicuous green streaks and also turns dark more rapidly than the other species; texture fine or very fine; grain straight, sometimes a little crossed, but never so strongly as in the yacals; a small, but very pretty silver grain; seasons well, neither checking nor warping much; easy to work. Durability at least III.

Uses.—Posts; beams, joists, rafters; flooring, sheathing, ceiling; masts and spars; ship planking and decking; doors; moldings; pestle shafts in rice mills; carriage panels; furniture, cabinetwork; carpenter's sawframes; on account of its smooth straight grain and toughness, should make excellent broom, rake, and hoe handles.

Supply.—One of the least abundant woods of the family, but still obtainable in considerable quantities.

Prices.—Sixty pesos to ₱150 per M.

Genus ISOPTERA.

Isoptera borneensis Scheff.

This species, with local names yacal and gísok-takpáng, has been reported from Zamboanga; the wood is practically indistinguishable from the yacals of the genus *Hopea.*

Genus PARASHOREA.

P. plicata Brand. BAGTÍCAN.

A tall straight tree, up to 180 centimeters in diameter; reported from practically every island and province where there is any heavy forest, except in northern Luzon. One of the most abundant species in the islands.

Local names.—Apnít or hapnít (Tay., Pol., Cam., Alb., Cat., Sor.); BAGTÍCAN (Neg.); baiúkan or baiúkan-pulá' (N. E., Pang., Lag.); balakbákan (Min.); binalíuan (Bul.); dañgióg (Cap.); danlíg (Tay.); danlóg (Cam.); dunlóg (Mas.); guíjo blanco (Zambo.); lauáan or lauán with various adjectives (Riz., Tay., Cam., Sor., Mas., Cap., Ley., Sam., Or. Neg., Cebu, Zambo., Sur., Dav.); malaanónang (Riz., Lag.); malakayán (Zambo.); manggasinóro (Mas.); mayápis (Tay., Zambo.); takúban (Cam.); yauáan (Sur.).

Wood of the lauan type; moderately hard; moderately heavy; sapwood whitish when fresh, turning light gray in drying, not very sharply marked off from heartwood; heartwood pale brown or reddish brown, turning slightly darker on exposure; grain generally distinctly crossed; texture rather coarse; seasons well, with little checking and warping; easy to work. Durability IV.

Structure.—Pith rays rather thin, not very distinct; pores rather small to moderately large, numerous, evenly scattered; soft tissue forming tangentially elongated patches about pores and numerous, short, irregularly scattered tangential lines; resin rings frequent; no growth rings.

Uses.—Siding, sheathing, ceiling, floors; doors, interior finish; concrete forms; dugouts, lighters, barges; boxes; furniture; general cheap or temporary construction.

Supply.—Very widely distributed and very abundant.

Prices.—Rarely sold alone, being generally mixed with the light-colored lauans sold at prices ranging from ₱30 upward; the average price during the last five years has been between ₱50 and ₱60.

Genus PENTACME.

P. contorta Merr. & Rolfe (Pl. VI, fig. 48.) WHITE LAUÁN.

A tall straight tree, up to 150 centimeters in diameter; found in almost all heavy dipterocarp forests up to 700 meters elevation.

Local names.—Apnít (I. N., I. S., Cag., Isa., Cam., Neg.); balagbág, balák, balakbák (Cag., Isa., Abra); bálau (Cag., Palaui); bayúkan (Zam., Lag.); buñgá (Cag., Abra); búgis (Dav.); dañgig (Agus.); dañgiog (Sib.); danlíg, danlóg (Tay., Cam., Sam., Neg., Lan., Bas.); diráan (Beng.); dunlúg (Bas.); gisían (Cam.); Lauáan or Lauáan na putí' (white lauán) (Abra, Bont., Beng., N. V., N. E., Pang., Bul., Zam., Bat., Riz., Lag., Tay., Alb., Sor., Min., Mas., Mar., Sam., Neg., Cota., Zambo., Bas.); malaanónang (Riz., Cam., Mas.); malakayán (Zambo.); malasinóro (Alb.); malatiáong, mayápis (Pol.); takúlau (I. N.); tiáong (Pol.).

Wood soft to moderately hard; light to moderately heavy; sapwood whitish, turning pale silvery gray in drying, but often staining to dirty grayish brown, not very sharply distinguished from heartwood; heartwood pale grayish brown to light reddish brown; grain distinctly crossed; texture somewhat finer than bagtican, taking a glossy finish under a sharp plane; seasons well; very easy to work. Durability IV.

Uses.—Same as bagtican.

Supply.—Probably the most widely distributed of its family and certainly one of the most abundant woods in the Islands.

Prices.—Thirty pesos to ₱60 per M.

Genus SHOREA.

A genus of about 20 species producing woods of widely varying character. The majority are of the lauan type, ranging from pale straw color to dark reddish brown, while guijo (*S. guiso*) resembles the apitongs (*Dipterocarpus* spp.) and gisok (*S. balangeran*) is difficult to distinguish from the yacals of the genus *Hopea*.

The following are the best known species of *Shorea;* the names of provinces cited after the local names of the trees indicate practically the whole distribution of each species.

S. balangeran Dyer (Pl. VII, fig. 49.) GÍSOK.

A tree up to 180 centimeters in diameter.

Local names.—Balang (Zambo.); bayábas or bayáuas (Pang.); duñgon (Agus.); gísik, GÍSOK, gisok-gísok, with many qualifying adjectives (Tay., Cam., Alb., Sor., Sam., Ley., Zambo., Dav.); malagáñgau (Tay.); malapánau (Cam.); malibató (Agus.); pamayauásen (Pang.); yakál (Pang., Tay., Alb., Zambo.); yambán, with various adjectives (Zam., Pang.).

Wood practically indistiguishable from the other yacals (*Hopea* spp.) and equal to it in strength and durability; of slightly finer texture and darkens less on exposure. A considerable proportion of the yacal in the markets is of this species.

S. eximia Scheff. ALMÓN.

A tall straight tree, up to 150 centimeters or more in diameter.

Local names.—ALMÓN (Neg.); bulá', dakúlau (Cam.); danlíg (Tay.); lauáan (Sor.); magsinólo (Mis.); malakayán (Zambo., Bas.); malasinóro, manggasinóro (Cam., Alb., Sor.); manggachapúi (Neg.); mayápis (Tay.); takúban (Cam.).

Wood of the lauan type; soft; light, specific gravity 0.464 (Gardner); sapwood small (2 to 5 centimeters), yellowish white, often staining slightly in drying, fairly sharply marked off from heartwood; heartwood very pale red, fading in time (even under varnish) to a uniform light yellow; texture rather coarse; grain somewhat crossed, making a narrow, distinct ribbon when quarter-sawn; small but distinct silver grain; seasons well, checking and warping very little; very easy to work. Durability IV.

Structure.—Pith rays fine, distinct, rather evenly spaced; pores medium to large, round or oval, sometimes partitioned, scattered singly or in small, irregular groups, some with iridescent resinous deposits; resin canals frequent, forming numerous and conspicuous rings; soft tissue in very thin rings about pores and in dim crosslines between rays, the lines widely scattered or sometimes almost entirely absent; no growth rings.

Uses.—About the same as bagtican and white lauan.

Supply.—Distributed from southern Luzon to Mindanao, abundant especially in Negros; one of the most abundant of the lauans.

Prices.—Thirty pesos to ₱60 per M.

S. guiso Bl. (Pl. VII, fig. 50.) GUIJO.[1]

A tree up to 180 centimeters or more in diameter.

Local names.—Antám (Isa.); aromói (Zam.); barusingsíng (Cag.); bétik, bítik (Riz., Lag.); dagingdíñgan (Mis.); daníri' (Tay., Cam.); gího' or GUIJO (Zam., Bat.); gísek, gísik, gísok, or gíso' (N. E., Pamp., Zam., Bat., Lag., Tay., Cam., Alb., Sor., Mas., Tic., Ley., Sam., Neg., Cota.); kuríat (N. E.); kuribu (Isa.); pamayauásen (Pang.); písak, písek (I. N., I. S.); sarrái (Cag.); sigái (Tar.); taggái (Cag.); yambán (N. E., Un., Pang., Zam.).

Wood moderately heavy to heavy, specific gravity 0.688 (Foxworthy) to 0.708 (Gardner); moderately hard to hard; tough; difficult to split; sapwood small (2 to 5 centimeters) light grayish brown, not quite sharply distinguished from heartwood; heartwood light ashy brown to brown, sometimes with distinct reddish tint; grain distinctly crossed; texture fine, taking both in longitudinal and cross sections a glossier finish than apitong (*Dipterocarpus* spp.); faint odor of resin; dries slowly and is very liable to split and warp if not seasoned carefully; not hard to saw, but rather difficult to shape and surface. Durability III.

Structure.—Pith rays fine, not conspicuous; pores rather small, scattered; soft tissue less abundant than in apitong, in thin, irregular rings about pores and short, indistinct tangential lines; resin rings frequent, narrow and distinct; growth rings sometimes faintly indicated in young trees; all the elements in guijo are smaller and more sharply defined than in apitong (*Dipterocarpus* spp.), so that the cross section has generally a cleaner look, so to speak, than in the latter.

Guijo is closely related to the Indian sal (*S. robusta* Gaertn.) and in general appearance and structure is extremely similar to it.

Uses.—Posts above stumps; beams, joists, rafters; floors; windows; doors; siding; sheathing; ceiling; ships' keels, planking, decking, etc.; bridge and wharf construction, except salt-water piles; furniture; probably the most widely used wood in the Islands for vehicle parts, such as cart and wagon beds; carriage floors, backs and dashboards; hubs, spokes,

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[1] Pronounced *gí-ho;* guijo is the Spanish spelling for *gího'*, the Zambales equivalent of the Tagalog, Bikol and Bisaya *gísik* and *gísok;* like narra and molave, also Spanish forms of native names, it has become more widely known and used throughout the Islands than any other one local name.

felloes, poles, shafts, reaches, hounds, etc.; recommended for treated ties and paving blocks.

Supply.—Found in almost all provinces and only less abundant than apitong. Supply in Manila market large and steady.

Prices.—Forty-five pesos to ₱120 per M.

A wood called guijo blanco is cut in Zamboanga and Basilan, which is somewhat lighter in color than average guijo; it is not known if it is a mere local variety or the product of a new species. It is said by wagon builders to be better than guijo, especially for steamed bent parts.

S. malaanonan Bl. MALAANÓNANG.

A tree up to 100 centimeters or more in diameter.

Local names.—Apnít (I. S.); baliwiswís (Pang.); danlíg (Tay.); lauáan, lauáan na putí' (N. E., Zam., Tay.); litok (Cag.); MALAANÓNANG (Riz., Tay.); manggasinóro (Tay.).

Wood of the lauan type; light; soft, sapwood small, paler than heartwood, not sharply distinguished; heartwood pale brown; grain straight or somewhat crossed; texture very much like white lauan; very easy to work. Durability IV.

Structure.—Pith rays rather fine, yellowish or pale brown; pores medium sized, evenly scattered; soft tissue forming rather conspicuous irregular rings or small patches about pores, often connecting several pores; resin rings fairly common and distinct; no growth rings.

Supply.—Found only in northern and central Luzon; one of the least abundant of the lauans. Not marketed as a separate species and, if found at all in Manila market, only mixed with other light-colored lauans.

S. negrosensis Foxw. (Pl. VII, fig. 51.) RED LAUÁN.

A tall straight tree, up to 200 centimeters in diameter.

Local names.—Aruás (Cag.); babañgánon (Sur.); balakbákan (Occ. Neg., Agus.); buñga (Cag.); damilang (Isa.); hinlagasí', il-lagasí' and similar forms (Sib.); kila, kuliáan (Sor.); magabolíng (Agus.); malagáñgau (Alb.); malasinóro (Sor.); malatbáng (Tay.); manggachapúi (Neg.); RED LAUÁN (Neg.); saplíg (Agus.); tañgíle or tanguile (Manila market).

Wood soft to moderately hard; light to moderately heavy, specific gravity 0.542 (Foxworthy), 0.406 (Gardner); sapwood 3 to 5 centimeters thick, reddish or brownish white, not quite sharply marked off from heartwood; heartwood light red to dark reddish brown; grain distinctly crossed, forming a conspicuous ribbon when quarter-sawn; texture rather coarse; seasons well, splitting and warping very little; easy to work. Durability IV.

Structure.—Pith rays moderately thick to thick, rather irregular both in thickness and spacing, indistinct; pores medium to large, numerous, evenly scattered; often partitioned, often with glistening resin deposits; soft tissue in rather conspicuous rings about pores and in irregularly scattered, short transverse lines; resin rings frequent and conspicuous, but very irregular and broken; no growth rings.

Uses.—All uses of white lauan and bagtican, but much more popular than these for interior finish and furniture on account of its color; red lauan forms at least nine-tenths of the bulk of the "Philippine mahogany," "South Pacific mahogany," etc., imported into the United States; so common has the use of these misleading names become that, when Philippine mahogany is mentioned in reports of lumber using industries or in

trade journals, it may be taken for granted in most cases that red lauan is meant. Some tanguile (*S. polysperma*) has, however, been shipped under this name, either alone or mixed with red lauan.

Supply.—Found in almost all islands, but abundant, so far as known, only in Negros and Sibuyan.

Prices.—Forty pesos to ₱80, except selected export grades, which run much higher.

S. polysperma Merr. (Pl. VII, fig. 52.) TANGUILE.

A tree up to 160 centimeters in diameter.

Local names.—Abuhúñgon, adumói (Alb.); baknítan, balagáyan (Min.); balakbákan (Tay., Cap., Neg.); balsían (Isa.); basílan (Bas.); chapúi (Neg.); gísok (Ley.); gísok-purá', hapnít (Cam.); hinlagasí', il-lagasí' (Sib., Cap.); lauáan (Min.); létis (Neg.); malagíso' (Bul.); malagmát (Lag.); manang (Cebu); manapuyog (Cap.); manggachapúi (Sur.); manggoórang, manilí (Cam., Alb.); matáñgan, matañgíd (Cag.); mayápis (Lag., Tay.); panuñgsúñgan (Cam.); pata (Pang.); taggaí (Isa.); tamók (Cag.); tañgili or TANGUILE (N. E., Pang., Bat., Lag., Min.); tugáui, tumutugáui (Cam.); in the export trade, "Philippine mahogany" and "Bataan mahogany."

The hardest, finest-grained and, with the exception of red lauan, the darkest red of the lauan class; soft to moderately hard; light to moderately heavy, specific gravity 0.469 to 0.509 (Gardner); sapwood thin (2 to 5 centimeters), pale grayish brown, not quite sharply marked off from heartwood; heartwood pale red to dark reddish brown; grain distinctly crossed, producing a broad conspicuous ribbon when quarter-sawn; silver grain small, but distinct; texture somewhat denser than most other lauans and taking a glossier surface under a sharp plane; seasons well, but may warp if not carefully stacked; easy to work. Durability III.

Structure.—Pith rays fine, less conspicuous than in most other lauans; pores small to fairly large, less numerous than in other lauans, evenly scattered, sometimes partitioned; soft tissue much scantier than in most other red lauans; resin rings frequent, distinct; the cross section bears about the same relation to red lauan (*S. negrosensis*) as that of guijo (*S. guiso*) to apitong (*Dipterocarpus* spp.) that is, it has a smoother, cleaner look; also tanguile has in cross section a pinkish or pale purplish tinge distinct from the pale to dark, dull brick red of the other red lauans.

Uses.—All the uses of red lauan, but preferred to the other lauans for fine work on account of its greater hardness and density and, excepting sapwood, somewhat greater freedom from attacks of beetles.

Supply.—Widely distributed, abundant from central Luzon to southern Tayabas.

Prices.—There is at present practically no true tanguile on the Manila market, the best selected stock being exported, while the remainder is sold with miscellaneous lumber; the bulk of the so-called tanguile on the market is red lauan or other species of *Shorea* from central and southern Luzon, Negros, Sibuyan and Mindanao. Has been quoted during 1915 at ₱60 to ₱75 per M., except for selected export grades.

S. squamata Dyer MAYÁPIS.

A tree up to 150 centimeters in diameter.

Local names.—Alám (Min.); balábak (Cag.); balakbákan (Lan.); baiúkan (Bul.); buñgá (Cag.); damílang (Isa.); danlíg (Tay.); gugumkúu (Isa.); kaliáan (Agus., Mis., Lan.;) kalúnti' (Zambo.); lauáan, with various adjectives (Tay., Sam., Ley., Sur.); lobók (Cam.); magasinóyo

(Agus.); malabalabáng (Cag.); malakayán (Zambo., Bas.); malasinóro (Ley., Sam.); mandarauá (Cag.); MAYÁPIS (N. E., Riz., Lag., Tay., Cam., Pol., Mar.); ogháyan (Sam.); purá' (Cam., Alb., Sor.); tabág or tabák (Tay., Mar.); ubánan (Agus.).

Wood of the lauan type; soft; light; sapwood small (2 to 4 centimeters), whitish, turning gray or brownish in seasoning, not very sharply distinguished from heartwood; heartwood pale red; grain somewhat crossed, producing a rather distinct, narrow ribbon; silver grain small, but very distinct; texture rather coarse in appearance, but wood takes a smooth, glossy finish; seasons well; very easy to work. Durability IV.

Structure.—Pith rays rather fine; pores small to moderately large, evenly scattered, often with glistening resin deposits; soft tissue in thin rings about pores; resin rings sometimes at quite regular intervals accompanied by belts of slightly lighter and darker wood, giving appearance of growth rings, especially in young trees.

Supply.—Found from northern Luzon to southern Mindanao, abundant in many regions.

Prices.—Rarely sold under its own name, but generally mixed with white lauan, red lauan or almon.

S. teysmanniana Dyer TIÁONG.

A tree up to 175 centimeters or more in diameter.

Local names.—Balakbákan (Agus.); bétik (Lag.); budgó (Cam.); bun͠gá (Cag.); hapnít (Cam.); hinlagasí', il-lagasí' (Sib.); malagíso' (Bul.); malatiáong (Pol.); manggachapúi (Neg.); manggasinóro (Sor.); mayápis (Lag., Tay.); pamanságan (Cam.); saplíd (Agus.); tamók (Cag.); TIÁONG (Lag., Tay.).

Wood of the lauan type; apparently very variable in color, the lightest specimens from Laguna resembling mayapis or very young red lauan, others mature tanguile, while one from Cagayan is dark reddish brown; in hardness, weight, grain, and texture generally like mayapis.

Structure.—Very much like that of mayapis.

Supply.—Widely distributed in Luzon, very abundant in Laguna and Tayabas.

Uses.—Same as red lauan and tanguile.

Prices.—Rarely comes into the Manila market, would sell as red lauan and at the same prices.

S. sp. KALÚNTI.

A tall straight tree, up to 180 centimeters in diameter.

Local names.—KALÚNTI, manggasinóro (Zambo., Bas.).

Wood of the lauan type; light; soft; sapwood small, scarcely distinguishable, but sometimes staining to grayish brown, when it becomes darker than heartwood; heartwood almost white when fresh, turning yellow or very light yellowish brown on exposure; grain straight or somewhat crossed; texture rather coarse; extremely easy to work. Durability IV; sapwood and wood of young trees very liable to attacks of pinhole beetles, but mature heartwood less so.

Structure.—Pith rays moderately thick, distinct, rather uniform both in thickness and spacing, often bending somewhat around pores; pores medium to large, round, sometimes partitioned, numerous, evenly scattered singly, in small irregular groups, or in short radial rows; soft tissue in thin rings about pores, rarely in small, irregular patches or short tangential lines; no growth rings.

Supply.—Known only from Zamboanga (including Basilan); abundant there.

Prices.—Rarely comes to Manila market under its own name; generally sold as white lauan or with miscellaneous lumber.

S. sp. DANLÍG.

Local names.—DANLÍG (Tay.); sarrái (Cag.).

A large tree, reported only from these two provinces, apparently not abundant, but said to be well known in Tayabas. Wood in every respect very similar to the following.

S. sp. MANGASINÓRO.

A tree 75 centimeters or more in diameter.

Local names.—Dalingdíñgan (Tay.); siyáu (Ley.); malasinóro, MANGASINÓRO (Tay.); manggachapúi (Tic.); tañgili (Bat.).

Wood of the lauan type; soft; light; sapwood small (2 to 4 centimeters), whitish, generally staining grayish in drying, not quite sharply marked off from heartwood; heartwood pale straw color when fresh, turning to light brownish yellow; grain straight or slightly crossed; texture fairly fine, taking a glossy surface under a sharp plane; seasons well; very easy to work. Durability IV.

Structure.—Pith rays fine, distinct, regular; pores medium sized, numerous, evenly scattered, with a tendency to arrange themselves in loops and irregular diagonal lines, giving a vague pattern; soft tissue inconspicuous, in thin rings about pores and widely scattered, short, dim cross-lines between rays; resin rings very rare; no growth rings.

Supply.—Known only from above provinces; best known in Tayabas; one of the less abundant lauans.

Prices.—Whether marketed under its own name or mixed with other light-colored lauans, about the same prices as white lauan.

S. sp. MALAKAYÁN.

Reported only from Zamboanga and Basilan, apparently rather rare; a soft, rather light red lauan, similar to tiaong (*S. teysmanniana*).

Genus VATICA.

V. mangachapoi Blco. (Pl. VII, fig. 53.) NÁRIG.

A tall slender tree, up to 70 centimeters in diameter.

Local names.—Anigá' (Beng.); aninggát (Pang.); asép (Pang.); atpái (Pal.); bagasúsu, bagangsúsu (Zambo., Mis., Lan.); baník (Cag.); bibít (N. E., Tay.); dágam (Cam.); danggi (Riz.); dúro' or dúrog (Sam., Ley.); dúyong (N. Tay.); gísok-madláu (Sam., Ley.); itílan (Riz.); kalanígen (I. S.); kaliót (I. N.); kárig, kariókan, kairókan (Bat.); labáng (I. S.); lisíkan (Riz.); lutub (Zambo.); nárik (I. S., Cag.); NÁRIG (Zambo., Cota.); pagsahíñgin (Lag.); palosápis (N. E., Lag.); paniggáyen (I. N.); payiná' (Tay.); putían (Pang.); salñgán (Sam., Ley.); salñgén (Pang.); salóñgan (Un.); salong-sálong (Alb., Sor.); salongsalóñgan (Agus.); sáung, saúñgan or saungsaúñgan (Sam., Ley.); saplúñgan (N. E.); tapúrau (Alb.); tiranglaí (Pang.); yakál blanco (N. Tay.).

There are at least six other species, so far very little known, of the genus *Vatica;* some of the above names belong to specimens of these unknown species, but as the trees are of the same habit and general appearance and the wood of the various species is apparently identical, the same name is given to all in any given locality where two species occur.

Wood hard to very hard; heavy to very heavy; sapwood often large (3 to 10 centimeters), rather sharply marked off from heartwood, straw color when fresh, but generally staining to light gray or brown in drying, much subject to attacks of both fungi and insects; heartwood pale yellow when fresh turning brown on exposure, often with small, indistinct dull greenish brown streaks and mottlings; grain straight or slightly crossed, showing little or no ribbon when quarter-sawn; silver grain fine and inconspicuous; texture very fine and dense, the smoothest and finest of all Philippine woods of this family; seasons well, warping and splitting less than the yacals; hard to saw and shape, but, on account of its fine and straight grain, fairly easy to surface. Durability I, except sapwood, which is larger and poorer than in any of the yacals.

Structure.—Pith rays numerous, of two sorts, moderately thick and very thin; pores smaller than in any other wood of the family, evenly scattered; resin canals scarce, very small; soft tissue almost absent; no growth rings.

Uses.—Same as yacal.

Supply.—Widely distributed, in parts of Mindanao abundant.

Prices.—Almost always sold as yacal and at the same prices.

FLACOURTIACEAE.

[Aranga family.]

Genus HOMALIUM.

A genus of about 10 species, most of them timber trees, the largest reaching a diameter of 95 centimeters. The general appearance, mechanical properties, and structure of all species are very much alike except for certain variations in color and density, which seem to be due partly to local conditions and not entirely to specific differences.

Wood hard; heavy, specific gravity 0.863 (Foxworthy), 0.859 (Gardner), 0.885 (Puigdulles); sapwood 3 to 5 centimeters thick, yellowish or pinkish, sometimes rather sharply marked off, sometimes merging gradually into heartwood; uncolored and colored heartwood very variable, former generally large and yellowish, pinkish, or pale red, latter generally small and reddish or pale chocolate brown, but sometimes whole heartwood very irregularly streaked and mottled; grain straight or slightly crossed; texture very fine, dense and smooth; seasons fairly well, checking and warping very little; hard to saw, but not difficult to shape and surface. Durability I; rarely attacked by termites and but slowly by teredo.

Structure.—Pith rays very numerous, fine to very fine, often bending around pores, frequently whitish; pores small, scattered singly or in short radial lines; soft tissue inconspicuous; growth rings, if present, very indistinctly marked.

Uses.—Piling; ship, wharf and bridge building; posts, sills, poles, ties, paving blocks; floors; interior finish; sash; furniture and cabinetwork.

Supply.—Widely distributed from northern Luzon to Mindanao, but scattered; well known, however, and generally a small but steady supply in Manila market.

Prices.—One hundred and ten pesos to ₱180 per M.

The following are the most important species of *Homalium:*

H. bracteatum Benth.

A tree up to 70 centimeters or more in diameter; reported from: I. S., Abra, Pang., Bat., Bul., Lag., Tay., Cam., Sam.

Local names.—Aráñgan (Lag., Tay., Cam.); kamúyau (Abra); malakamáñga' (Bat.); matambokál (I. S.); pañginaháuan (Sam.).

H. luzoniense F.-Vill. (Pl. VII, fig. 54.) ARÁNGA.[1]

A tree up to 70 centimeters or more in diameter; reported from: Tay., Cam., Cota.

Local names.—Aráñgan (Tay., Cam.); kamagáhai, kamagáhi' (Cam.); malatumbága (Cota.).

H. oblongifolium Merr.

A tree up to 75 centimeters in diameter; reported only from Zamboanga, with local names aranga (?) and banaui, the latter belonging properly to *Cyclostemon* spp.

The wood seems to be of slightly finer texture than that of other species; otherwise, it is identical with aranga.

H. villarianum Vid.

A tree up to 35 centimeters or more in diameter; reported from: Lag., Sor., Sam., Ley., Mis.

Local names.—Adánga (Sor.); matobató (Sam.).

Genus TRICHADENIA.

T. philippinensis Merr. MALAPINGGÁN.

A tree up to 70 centimeters in diameter; reported from: Pang., Riz., Lag., Tay., Cam., Sib., Cap., Neg.

Local names.—Banáu (Cam.); banáog (Sib.); ibol (Pang.); lináb (Cap., Neg.); MALAPINGGÁN (Tay., Cam.); malapáñgi (Neg.).

Wood hard; heavy; sapwood and heartwood scarcely distinguishable; yellowish to light brown; grain somewhat crossed; texture slightly coarser than aranga; seasons with little warping, but liable to check internally; fairly easy to work. Durability II; not attacked by beetles.

Structure.—Very much like aranga, but pith rays thicker and more wavy, pores larger, and whitish deposits in pith rays more abundant.

Uses.—Posts; beams, joists, rafters; flooring; interior finish.

Supply and prices.—Scarce; is not known by name to Manila lumbermen and consequently occasional logs or small lots of lumber are sold with miscellaneous stuff, selling at about ₱75 per M. and upward.

DATISCACEAE.

A family containing, in the Philippines, only a single timber tree.

Genus OCTOMELES.

O. sumatrana Miq. (Pl. VII, fig. 55.) BINUÁNG.

A tall tree up to 100 centimeters or more in diameter; reported from: Cag., Zam., Bat., Riz., Lag., Tay., Cam., Min., Dav., Zambo., Pal.

Local names.—Barawísan, barawiswísan (Lag.); biluáng or BINUÁNG (Lag., Tay., Zambo., Pal.); libás or libás na putí' (Lag., Tay.); sarrái (Cag.).

Wood soft; light; brittle; sapwood large (10 to 15 centimeters), but scarcely distinguishable from heartwood in color; heartwood yellowish white, turning pale yellowish brown; grain strongly crossed in broad belts, forming a very conspicuous broad ribbon on radial sections; texture coarse and rough; no growth rings; in general appearance similar to loktob (*Duabanga moluccana*), but quite distinct in structure.

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[1] Pronounced *aráng-ga*; the Spanish spelling and pronunciation of the Tagalog *aráñgan*.

Structure.—Pith rays moderately broad, few, rather even in thickness and spacing; pores numerous, large, very evenly scattered, a few partitioned; soft tissue inconspicuous; no growth rings.

Uses.—Buoys for rafts of heavier timber; dugout canoes; cheap and temporary construction; box lumber; would make a good match-box veneer.

Supply.—Widely distributed, river bottoms and clearings, but generally very scattered.

Prices.—Marketed only in miscellaneous lots of cheap lauan.

LYTHRACEAE.

[Banaba family.]

Genus LAGERSTROEMIA.

L. piriformis Koehne (Pl. VII, fig. 56.) BATITÍNAN.

A tree up to 90 centimeters in diameter; straight but not tall.

Local names.—Bagunárem (Dav.); bagunáum (Zambo., Dav.); baluknít (Cag.); banabáng-bugtúng (Riz.); banábang-dinglás (Tay.); banabáng-tináan (Riz.); basít (Zambo.); batikalág (Pang.); BATITÍNAN (Batg., Tay., Cam., Alb., Sor., Sam., Agus., Zambo.); bug'áom, bug'árom, buguárom (Sam.); dinglás (Tay.); dumáte (N. Luz.); lasíla' or lasílak (Ilk., Cag.); línau (Sor.); lumáti (I. S.); lumpían (Sam.); magaklúd (Cota.); magatalulóng (I. S.); magugáhum (Agus.); mangláti (Bis. Is.); naghubó' or nathubó' (Lag.); pamalauágon (Ley.); salulúng (Cag.); talulúng (N. E.); tináan (Cam., Alb., Sor.); sometimes called "Philippine teak."

Wood hard; heavy, specific gravity 0.769 (Foxworthy), 0.795 (Gardner); sapwood variable, sometimes small (1 or 2 centimeters) and sharply distinguished, sometimes much larger (4 to 6 centimenters) and merging gradually into heartwood, whitish when fresh, turning grayish brown on exposure, in wood from young, fast-growing trees hardly distinguishable from heartwood after seasoning; heartwood light olive gray to dark grayish brown; distinctly ring-porous and so showing on slash-sawn boards a figure with narrow open and broad dense grain similar to that of ash; grain generally straight, sometimes with a short, very regular wave; texture fine, dense, smooth; seasons with little warping, but liable to split badly at ends; logs and freshly trimmed ends of sawn lumber should be painted to prevent splitting; rather difficult to work, but takes a beautifully smooth surface under sharp tools. Durability I; rarely attacked even by teredo and termites.

Structure.—Pith rays numerous, fine, rather indistinct; large pores in an irregular, crowded, double or triple row in inner part of growth ring, growing gradually smaller and fewer in outer part; frequent glistening deposits (probably tyloses) in pores; soft tissue conspicuous, in irregularly rounded patches about large pores, toward middle of ring tending to become confluent and form broken, wavy lines and at end of ring generally forming one or two continuous lines; growth rings sometimes broad (1 to 1.5 centimeters) and very distinct, but when narrower, as in wood of old, slow-growing trees, very much less conspicuous.

Uses.—Ship, wharf, and bridge building, including salt-water piles; ties; paving blocks; sills; posts; beams, joists, rafters; flooring, interior finish; furniture, cabinetwork.

Supply.—Widely distributed, but scarce.

Prices.—One hundred and eighty pesos to ₱200 per M.

L. speciosa Pers. (Pl. VIII, fig. 57.) BANABÁ.

Local names.—BANABÁ (throughout Luz., in Min., and parts of Bis. Is.); bug'árom (Sam.); dugáum (Ley.); kauílan (Guim.); makabálo (Pang.); mitlá (Pamp.); nabulong (Cag.); pamarauágon (Ley.); parabukúng (Mis.); tabañgáu or tagbañgáu (I. S., Cag.).

Wood ashy rose to reddish brown; in every other respect very similar to batitinan in general appearance and structure, but somewhat softer, lighter and easier to work; seems to season better than batitinan; put to about all the same uses; more widely distributed and known, but trees are scattered and small, therefore much scarcer in Manila market. Prices about same as batitinan.

SONNERATIACEAE.

[Pagatpat family]

A family represented in the Philippines by only two timber trees, which have wood of very different character.

Genus DUABANGA.

D. moluccana Bl. LOKTÓB.

A large tree, up to 90 centimeters or more in diameter; reported from: I. N., Cag., I. S., Isa., Abra, Bont., Beng., N. V., N. E., Bul., Riz., Lag., Batg., Tay., Cam., Alb., Min., Neg., Agus., Cota., Zambo., Pal.

Local names.—Arík (Cag.); binuáng (Bul., Riz.); búkag (I. S.); buyúkan (N. V.); daha (Neg.); dapul (Abra); kadíl (Abra); kadír (I. N., Cag.); kárig (Cag.); LOKTÓB, luktúb and similar forms (Lag., Tay., Cam., Min., Zambo.); malapalikpík (Riz.).

Wood soft; light, specific gravity 0.384 (Puigdulles); sapwood 6 to 8 centimeters thick, yellowish, not quite sharply marked off from heartwood; heartwood yellowish gray to light brown; grain crossed in broad bands; texture coarse, rough; in general appearance much like binuang (*Octomeles sumatrana*), but very distinct in structure; does not split and warp in drying, but liable to stain badly if not seasoned quickly; extremely easy to work. Durability poor, but not often attacked by beetles.

Structure.—Pith rays numerous, fine to medium sized, indistinct, often bending around pores; pores numerous, medium sized to large, often partitioned, evenly scattered or with a tendency to form diagonal patterns, rarely with yellowish deposits; soft tissue in irregularly rounded, ill-defined patches about pores, sometimes running together in wavy tangential or diagonal lines; growth rings absent or very indistinct.

Uses.—Floaters for rafting heavy logs; fish-net floats; dugout canoes; light or temporary construction.

Supply and prices.—Scarce; logs unknown in Manila market; larger operators cut it occasionally with the cheapest miscellaneous lumber, selling at not over ₱40 per M.

Genus SONNERATIA.

Two or three species, only one of any importance; the same local names are given to all and the wood is identical in structure.

S. caseolaris Engl.

A small tree, reported from: Cag., Bat., Man., Pal. Rarely if ever forms heartwood and is cut only with mixed inferior firewoods.

S. pagatpat Blco. (Pl. VIII, fig. 58.) PAGATPÁT.

A medium-sized to tall tree of the mangrove swamps, up to 100 centimeters in diameter, generally with a straight regular bole; it probably occurs in all mangrove swamps, but in many regions is of comparatively small size; the largest trees are found in Mindanao; reported from: Cag., Zam., Bat., Tay., Pol., Cam., Min., Mas., Ley., Ilo., Guim., Cebu, Neg., Mis., Lan., Cota., Zambo., Bas., Pal.

Local names.—Bun͠gálon (Mas.); ilukabbán, lukabbán (Cag.); PAGATPAT in most other regions; palalan, pedada or pirara (Cota.); palatpát (Bat.); patpát (Agus.).

Wood moderately hard; moderately heavy to heavy; sapwood 3 to 8 centimeters thick, grayish brown; heartwood light brown to dark chocolate; when wet or under varnish, heartwood of old mature trees looks almost black; grain straight or very slightly crossed; texture fine, very homogeneous, smooth, but not glossy; distinct salty taste; fishy or "swampy" odor, especially when fresh; boards season fairly well, but logs and heavy planks are liable to check internally; easy to work; rusts out small nails or screws, on account of salt content. Durability II; even sapwood rarely attacked by insects and heartwood said to resist teredo very well.

Uses.—Piles; posts; poles; ties; paving blocks; ship, bridge, and wharf building; general strong construction; doors; siding, sheathing, ceiling, flooring and all kinds of interior finish; ship planking and decking; furniture and cabinetwork; musical instruments.

The large knees or air roots, known as dalúru, are used for razor hones, fish-net floats, and as a substitute for cork in the velvet trimmed, cork-soled slippers called "corchos;" they are recommended for bottom lining (in place of cork) for entomological specimen cases and for thumb-tack holders; would probably also furnish a good material instead of cork or pith in the manufacture of tropical sun helmets.

Supply.—Though widely distributed, so far found of large size only in Mindanao and the surrounding small islands; there has been a fairly steady supply in the Manila market for some years.

Prices.—Fifty pesos to ₱95 per M.

LECYTHIDACEAE.[1]

[Putat family.]

Genus BARRINGTONIA.

A genus of small to medium sized trees, only one of which, botong, is of any importance.

B. asiatica Kurz (*B. speciosa* Forst.). BÓTONG.

A tree up to 75 centimeters in diameter, short and often irregular.

Widely distributed on and near sandy beaches and almost always with the name BÓTONG or botong-bótong.

Wood light; soft to moderately hard; sapwood large (6 to 10 centimeters), pale, rather sharply distinguished from heartwood; heartwood pale reddish brown, sometimes with narrow, irregular, dark streaks; grain somewhat crossed; texture fairly fine and smooth, not glossy; seasons well; easy to work. Durability about III; not commonly attacked by beetles.

Structure.—Pith rays fine, numerous, rather indistinct; pores small to fairly large, often partitioned, numerous, evenly scattered, singly or in radial

[1] See footnote on p. 186.

rows of 2 to 4; soft tissue in very numerous, short and irregular straight or crooked crosslines, forming with the rays a fine lacelike pattern; growth rings marked by vaguely defined belts of denser tissue.

Uses.—Little used except locally for posts and beams and household or agricultural implements; impregnated, would make good ties and paving blocks; also a pretty cabinet wood.

Supply.—Found on almost all beaches, but rare toward interior and nowhere abundant.

Prices.—Not marketed except an occasional log with miscellaneous lots.

B. luzonensis Rolfe, *B. racemosa* Bl., *B. reticulata* Merr., *B. revoluta* Merr., all known as PÚTAT (Tag., Bkl.); latubá (Cag.); páling (Cag.), himbabálud (Cap.), etc., are small trees with soft, light, perishable wood.

Genus PLANCHONIA.

P. spectabilis Merr. LAMÓG.

A tall, straight tree, up to 100 centimeters or more in diameter.

Local names.—Apálang (Bat.); balat-usín (Cam.); bansalágin (Neg.); buhúkan (Mas.); dúñgon (Neg.); LAMÓG (Bat., Lag., Tay.); malapútat (Lag.); malatagúm (Cam.); motong-bótong (Cam., Alb.); paronot (I. N.); pútat (Cag.); úban (Tay.).

Wood hard; moderately heavy; sapwood 4 to 8 centimeters thick, pale grayish brown, sharply distinguished (in large trees) from heartwood; heartwood deep reddish brown, resembling toog and tuai, with regular or irregular lighter and darker belts; grain straight or slightly crossed, sometimes curly; texture fairly fine and smooth; does not warp much, but liable to honeycomb badly if seasoned in large pieces; fairly easy to work and takes a glossy surface under a sharp tool. Durability II; very rarely attacked by beetles.

Structure.—Pith rays numerous, fine to very fine, often bending around pores; pores numerous, scattered singly or in radial groups of 2 to 4, in sapwood open, in heartwood generally more or less filled with soft tissue; soft tissue also in very numerous irregular crosslines, forming a lacelike pattern with the rays; growth rings very ill defined.

Uses.—Posts; beams, joists, rafters; flooring; interior finish; a beautiful cabinet wood, that deserves to be better known.

Supply.—Widely distributed in Luzon and Bisaya Islands, but scattered; rarely comes into Manila market except with medium-grade miscellaneous lots, but is sometimes ignorantly or fraudulently substituted for betis, bansalagin or other heavy, dark red woods.

Prices.—About ₱70 to ₱120 per M.

RHIZOPHORACEAE.

[Bacauan family.]

The trees of the bacauan or mangrove family form a very large proportion of the total area of the tidal swamps of deltas, estuaries, and protected shallow bays. The pototans (*Bruguiera* spp.), the bacauans (*Rhizophora* spp.), and tangal (*Ceriops tagal*) are found only in such situations. Bacauan-gubat (*Carallia integerrima*), which is a forest species, has wood of a quite different character from the swamp species. The mangroves furnish a very large proportion of the firewood used in the vicinity of the swamps and in the larger centers of population, to which the wood is brought over great distances both by land and by water, principally the latter.

Genus BRUGUIERA.

A genus of four species which have practically identical wood. They are most commonly known (and in the Manila market almost exclusively) as pototan, though the wood is often mixed with and sold as bacauan, the latter being the most widely known and used name in the whole family. Busain and pototan are typically larger and straighter trees than langarai and pototan-lalaki; the last named is the shortest and crookedest of the four.

Wood hard; heavy to very heavy; sapwood 2 to 4 centimeters thick, sometimes merging gradually into darker heartwood, but often almost indistinguishable from it; heartwood pale dull red or reddish brown; sometimes with very irregular narrow but ill-defined dark streaks; grain straight; texture fine; beautiful conspicuous silver grain on radial sections; logs check badly in seasoning, but sawn lumber seasons without much checking and warping if properly stacked under roof; hard to saw, but otherwise easy to work. Durability III, but said to last well in wet situations, is rarely attacked by insects, and said to resist teredo for as much as seven or eight years.

Uses.—Salt water and foundation piling; mine timbers; house posts; furniture and cabinetwork; properly sawn and carefully seasoned would make an excellent flooring; on account of its shape, great strength and durability when submerged in fresh water, specially recommended for submerged foundation piles; a considerable part of the firewood brought to Manila as bacauan is really pototan.

Supply and prices.—Abundant in mangrove swamps, but little cut and marketed, except firewood sizes; occasional lots mixed with miscellaneous lumber of harder grades sell at prices ranging from about ₱70 per M. upward.

The following are the Philippine species of *Bruguiera*, as reported from botanical collections, but it is probable that all four species are found in almost all mangrove swamp regions:

B. gymorrhiza Lam. (Pl. VIII, fig. 59.) BUSÁIN.

A tree up to 75 centimeters in diameter; reported from: Cag., Zam., Bat., Tay., Min., Ley., Neg., Sur., Zambo., Bas., Cul.

Local names.—Bakáu (Zam.); bakáuan (Min.); BUSÁIN or similar forms (Min., Tay.); potótan or putútan (Cag., Bat., Tay., Min., Neg., Ley., Zambo., Bas.).

B. caryophylloides Bl. POTÓTAN-LALAKI.

A tree up to 40 centimeters or more in diameter; reported from: Pang., Bul., Tay., Min., Cebu, Neg., Cota., Cul., Pal.

Local names.—Bakáuan (Min.); biús (Cota.); busáin (Min.); hiñgáli (Neg.); lagárai, lañgárai (Cota.); magtoñgóg, (Mas.); potótan and POTÓTAN-LALÁKI (Tay., Min.).

B. eriopetala Lam. POTÓTAN.

A tree up to 65 centimeters in diameter; reported from: Cag., Palaui, Bat., Man., Tay., Cam., Min., Mas., Mis., Lan., Cota., Zambo., Bas., Pal., Taw.

Local names.—Álai (Pal.); bakáuan (Man.); balinsaráyan (Tay.); busáin, busáing, etc. (Tay., Min., Lan., Zambo.); gutulán (Cag.); lagása', (Cag.); lagásak (Palaui); POTÓTAN or putútan (Tay., Min., Mas., Mis., Cota., Zambo., Pal.).

B. parviflora W. and A. LAÑGÁRAI.

A tree 45 centimeters or more in diameter; reported from: Cag., Zam., Batg., Tay., Pol., Cam., Min., Mas., Ley., Ilo., Neg., Zambo.

Local names.—Bakáuan-laláki (Batg.); hañgálai or hañgárai (Min., Mas., Ley., Ilo., Neg.); hiñgálai (Pol.); LAÑGÁRAI or lañgári' (Zam., Tay., Mas., Neg., Zambo.); potótan (Cag., Tay., Zambo.).

Genus CARALLIA.

C. integerrima DC. (Pl. VIII, fig. 60.) BACÁUAN-GÚBAT.

A tree up to 40 centimeters or more in diameter; reported from: N. E., Pang., Bat., Riz., Lag., Tay., Min., Ley., Sib., Zambo., Pal., Sulu Arch.

Local names.—Anosép (N. E.); BACÁUAN-GÚBAT (Bat., Lag., Min.); bilúkau (Bat.); dílang-usá (Min.); kuling-manúk (Riz.); magua (Min.); takláng-anák (Bat.); tandúl (Sulu Arch.).

Wood moderately hard; moderately heavy to heavy; sapwood pale red, not sharply distinguished from light red to light reddish brown heartwood; grain straight; texture rather coarse in appearance, but fairly dense; very conspicuous silver grain; seasons with little checking or warping; easy to work. Durability under severe conditions probably not high, but not attacked by beetles.

Structure.—Pith rays numerous, of two kinds, very fine and very thick, 3 to 6 fine ones between every 2 thick ones; pores numerous, moderately large, crowded in irregular groups and in radial rows between large rays; soft tissue about pores mostly grayish, in irregular cross lines between rays, mostly of same reddish color as the latter; no growth rings.

Uses.—Locally for posts and structural timber; furniture and cabinet-work; musical instruments; a very pretty, easily worked and durable cabinet wood.

Supply and prices.—Not known by name in the Manila market and only comes in occasionally in lots of cheap miscellaneous woods.

Genus CERIOPS.

Two species, the smallest trees of the mangrove family in the Philippines.

C. roxburghiana Arn.

A tree up to 20 centimeters in diameter; reported from: Bat., Tay., Cam., Min., Ilo., Neg.

Local names.—Bakáuan (Bat., Min.); matañgál (Bat.); tañgál (Tay., Cam.); tuñgúg (Neg.).

Wood identical with following; there is some doubt as to *C. roxburghiana* being a distinct species.

C. tagal C. B. Rob. (Pl. VIII, fig. 61.) TAÑGÁL.

A tree up to 35 centimeters in diameter; reported from: Cag., Pang., Zam., Bat., Tay., Min., Mas., Mar., Neg., Cap., Cota., Zambo., Malamaui, Cul., Pal., Taw.

Local names.—Magtoñgód (Min.); rúñgon (Pang.); tagása' (Bat); TAÑGÁL, (Zam., Tay., Mar., Neg., Zambo.); tañghál (Min.); toñgóg, tuñgúd, tuñgúg, etc. (Mas., Cap., Neg., Taw.).

Wood very hard; very heavy; sapwood small, scarcely distinct from heartwood; heartwood orange red changing on exposure to reddish brown; gives an iridescent orange red color to water; grain straight; texture

very fine and dense, taking a smooth, almost polished surface under sharp tools; does not check badly, but somewhat liable to warp in seasoning; not difficult to work except for its hardness.

Uses, supply and prices.—Much the same as the pototans and bacauans, but scarcely ever seen as saw timber, on account of its scarcity and small size; much used locally for posts, beams and rafters (round) of small houses; treenails, wedges, etc.; when brought to Manila market as firewood, separated from and sold at somewhat higher prices than the bacauans and pototans.

Genus RHIZOPHORA.

Two species, in mangrove swamps; wood practically indistinguishable.

Local names.—Bakáu (sometimes bakháu in Bkl. and Bis.), BACÁUAN, bacáuan-laláki, and BACÁUAN-BABÁE (throughout the Islands; the last two not constantly given to the same species in different regions); the only other names recorded on botanical collections are parak (Cul.) and uakátan (Min.).

R. conjugata L. BACÁUAN.

A tree up to 50 centimeters in diameter; reported from: Cag., Zam., Bat., Tay., Cam., Min., Mar., Ley., Ilo., Cebu, Neg., Cota., Zambo., Bas., Pal.

Wood slightly harder and heavier than the pototans; sapwood 3 to 5 centimeters thick, in old trees very sharply distinguished from dark orange red heartwood; grain straight; texture fine and dense; conspicuous silver grain; logs and large timbers liable to check badly, but if properly sawn and carefully stacked seasons with little warping and splitting; hard to saw, but not otherwise difficult to work. Durability of sapwood poor, but heartwood as good or better than the pototans.

Structure.—Practically identical with the pototans (*Bruguiera* spp.).

Uses.—Same as the pototans; with the exception of tangal, the best firewood brought to Manila in large quantities.

Supply and prices.—Little cut for saw timber; comparatively small quantities have been shipped from Mindanao in small and medium dimension stock and sold in Manila at ₱100 to ₱120 per M.

R. mucronata Lam. (Pl. VIII, fig. 62.) BACÁUAN-BABÁE.

A tree somewhat larger than bacauan; reported from all the same islands and provinces as bacauan, except Cag., Mar., and Ley.

Wood in all respects practically identical with preceding; it is impossible to say which of the two furnishes the greater bulk of the timber and firewood brought to market.

COMBRETACEAE.

[Talisay family.]

A family which furnishes a number of woods which, though not abundant, are of considerable value as general construction, interior finish, and furniture woods.

The wood of tabau (*Lumnitzera* spp.) is of fine texture and even grayish or brownish color. That of the talisay group (*Terminalia* spp.) is of rather coarser texture (except binggas), but has a pretty grain and a variety of pleasing colors. The species of *Terminalia* have, as a rule, rather fine pith rays, scattered pores and soft tissue forming a characteristic pattern difficult to describe, but easily recognized after a little practice.

Genus LUMNITZERA.

L. littorea Voigt (Plate VIII, fig. 63.) TABÁU.

A small to medium sized tree, up to 50 centimeters in diameter, with a straight, fairly long bole.

Local names.—Anilai (Min.); baktíng, banting (Taw.); bulokbúlok (Occ. Neg.); dalúru-babáe (Tay.); dulokdúlok (Mas.); kalapíni' (Zam.); karifurog (Cag.); kulási' (Min.); libáto (Tay., Pol.) magalolo (Pol.); panting-pantíng (Bas.); papásil (Tay.); saga'sá' (Din.); sala'sá' (Occ. Neg.); santing (Taw.); TABÁU (Mas., Neg., Zambo.).

Wood moderately hard to hard; heavy; sapwood and heartwood hardly distinguishable, pale brown; grain straight; texture fine, dense and smooth, taking a silky finish under a sharp plane; when fresh, with faint odor of roses; seasons well and is easy to work. Durability I.

Structure.—Pith rays fine, very numerous; pores small in very regularly scattered radial rows of 2 to 6; soft tissue inconspicuous; growth rings faint, irregular, sometimes marked by a narrow belt of darker, denser tissue.

Uses.—Piles, poles and house posts; ties; paving blocks; bridges and wharfs; general strong construction; ship planking and decks; handles; cabinetwork.

Supply.—Very limited.

Prices.—Not known in Manila market and would be brought in only with miscellaneous lumber; about 5 per cent of tabau is sometimes found in large mixed lots of ties sold at ₱1.50 to ₱1.75 per tie.

L. racemosa Willd. KULÁSI.

KULÁSI, known also as tabau, has the same qualities, but is a much smaller tree and so is still more rarely cut.

Genus TERMINALIA.

T. calamansanai Rolfe MALAKALUMPÍT.

A tall, straight tree, up to 50 centimeters or more in diameter; reported from: Cag., Abra, Beng., N. E., Pamp., Zam., Bat., Riz., Lag., Tay., Sor., Mas., Neg., Ant., Sur., Agus., Dav., Zambo., Pal.

Local names.—Bangkalaguán, bangkaláuag (Tag., Bis.); bayábo (I. S.); bisál, busíli (Pang.); buráwis (Pal.); dikang (Pamp.); kalamansáli' (Zam., N. E.); kalamansánai (Tag., Bis.); kalumpít (Cag., Bat., Tay.); kalumpít-babáe (Bat.); kalupít (Cag.); lumáñgog, lumánog (Sur.); mabantút (Bat.); magtalísai (Tay., Sor., Mas., Dav.); MALAKALUMPÍT (Bat., Lag., Cam.); pañgalusíten (Abra); sákat (N. E.); ságet, sáket (Beng.); samburágat (Pal.); sulo'-súlo' (Zam.).

Wood moderately heavy to heavy; moderately hard; whitish when fresh cut, changing to grayish yellow; no distinct heartwood; grain often finely wavy or curly, with a distinct figure formed by concentric bands of soft tissue; texture rather coarse in appearance, but smooth. Durability IV; often attacked by shot-hole beetles.

Structure.—Pith rays numerous, fine, indistinct; pores medium to large, sometimes partitioned, few, scattered; soft tissue very conspicuous, surrounding and connecting pores and forming numerous, very wavy, sometimes branching and confluent concentric lines, often half as broad as intervening dense tissue; no growth rings.

Uses.—Cheap or temporary construction; cheap furniture; paving blocks, ties, mine timbers (treated).

Supply.—Limited.

Prices.—Sold only with cheap miscellaneous lumber.

T. catappa L. TALÍSAY.

A tree of medium height, up to 75 centimeters in diameter; found in almost all beach-type forests and in river bottoms, also often planted in and about towns.

Local names.—Logó (Cag., I. S., Un.); sabidug (Bats.); salaisái (Beng.); salísai (Zam., Bat.); TALÍSAY (Cag., Zam., Tar., Bul., Bat., Riz., Man., Lag., Tay., Cam., Alb., Sor., Min., Neg., Ilo., Cota., Pal.); talísi' (Bas.).

Wood moderately hard; moderately heavy; specific gravity about 0.700; sapwood in young trees large, whitish, in old trees hardly distinguishable from heartwood; heartwood rather variable, from light to dark brown, sometimes reddish brown and often with irregular darker and lighter belts; grain crossed and often curly and twisted; texture rather coarse; seasons well; easy to work; chips soaked in water give yellow color. Durability at least III.

Structure.—Pith rays fine, often wavy; pores few, moderately large to large, often partitioned, scattered; soft tissue in thin irregular rings about pores, frequently connecting pores, and forming numerous, very irregular, broken tangential lines; occasional whitish deposits in pores; growth rings irregular and indistinct, sometimes marked by a narrow belt of denser tissue.

Uses.—Beams, joists, rafters; posts above stumps; flooring, sheathing, ceiling; furniture and cabinetwork.

Supply.—Limited.

Prices.—Rarely comes to Manila market; if sold on its own mèrits or under the name calumpit, would probably bring not over ₱100 per M.

T. comintana Merr. BINGGÁS.

A tall, fairly straight tree up to 100 centimeters or more in diameter; reported from: I. N., Cag., I. S., Isa., N. E., Pang., Pamp., Zam., Bat., Riz., Lag., Batg., Tay., Cam., Alb., Min., Mas., Tic., Neg., Dav., Zambo., Pal.

Local names.—Agáru (Pang.); apuñgá (Bat.); bañgayás (Min., Tay.); bañglís (I. N., N. E., Zam.); batitínan-babáe (Tic.); biñgas (Bat.); BINGGÁS (Zam., Bat., Lag., Mas., Zambo.); bunggás, bunggáson-tugás (Ley.); bunglás (Mas., Neg.); bungrás (Alb.); dinglás (Bat., Lag., Batg., Tay.); hinabuád, hinabusí (Min.); laknáb (N. E.); lasíla', lasilak, lasilásan (I. S., I. N., Cag.); maglalopoi (Pang.); maghúbo', naghúbo' (Riz.); malatagúm (Zambo.); maupat (Pal.); paghúbo', pálang (Riz.); rubían (Lag.); tañgísan (Pamp., Mas.); tirorón (Cam.).

Wood hard; heavy; sapwood large (5 to 10 centimeters), yellowish white when fresh, turning to pale grayish brown; heartwood irregular in outline, grayish or brownish with dark purplish brown streaks; grain straight; texture fine, smooth; seasons well and works very smoothly. Durability at least III; even sapwood is not attacked by beetles.

Structure.—Pith rays fine, numerous, whitish, often bending around pores; pores small to medium, numerous, evenly scattered, frequently partitioned; soft tissue not conspicuous, forming small irregular patches around and between pores, and scattered, irregularly wavy, tangential lines; growth rings inconspicuous, marked by irregular bands of denser tissue.

Uses.—Posts above stumps; beams, joists, rafters; floors; sheathing; ceiling; furniture and cabinetwork.

Supply.—Limited.

Prices.—Eighty pesos to ₱100 per M.

T. edulis Blco. CALUMPÍT.

A tall and straight tree, up to 60 centimeters or more in diameter; reported from: Cag., I. S., Bont., Lep., N. E., N. V., Pang., Tar., Bul., Zam., Bat., Riz., Lag., Tay., Pol., Cam., Sor., Min., Mas., Sam., Sib., Neg., Guim., Agus., Zambo., Pal.

Local names.—Alupí' (Cag.); báho (Pal.); balisáyin (Min.); baraús (Pal.) basí (N. V.); besí (N. E.); bisál (Bul.); buluáng (Bis.); dalinsí' (Lag., Tay.); dirigkalín (Cam.); disi (N. V.); gayumáhin (Zam.); gísit (N. V.); kalamansánai (Riz.); kalautít (I. S., Cag., Beng., N. V., Pang., Zam., Tar.); kalumágon, kalumánog or kalumáñgog (Cam., Sor., Mas., Sam.); kalumpít or CALUMPÍT (Zam., Tar., Bul., Riz., Lag., Tay., Cam., Sor., Mas., Min., Zambo.); kalupí', kalurig (Cag.); kalusi', kalusít (I. S., Cag.); kamaris (Pal.); kotmók (Cam.); magtalísai (Sor., Mas., and Bisayas); sákat (Lag.); tako (N. Luz.); talísai (Sulu); tañgál (Cam.); taya-táya (Guim.).

Wood moderately heavy; moderately hard; sapwood and heartwood very much as in talisay, but more even and of rather lighter tint; grain as a whole straight, but slightly crossed and often with a short, very regular wave; texture somewhat finer and glossier than talisay; colors water yellow. Durability III.

Structure.—Pith rays fine to medium, light brown; pores medium to large, scattered, occasionally with minute deposits (tyloses?) that glisten like soap bubbles; soft tissue similar to talisay; growth rings sometimes fairly distinct, marked by a belt of denser tissue.

Uses.—Same as talisay.

Supply.—Limited.

Prices.—About ₱80 to ₱100 per M.

T. nitens Presl (Pl. VIII, fig. 64.) SÁCAT.

A tree up to 90 centimeters in diameter; reported from: Cag., I. N., I. S., Pang., Tar., Zam., Bat., Bul., Riz., Lag., Batg., Tay., Min., Mas., Sib., Cota., Zambo., Pal.

Local names.—Anagép (I. S.); arinbukál (Tar.); bisál (Pang.); dalinsí' (Tay.); háket (Zam.); kalautít (I. N., I. S.); kalaupí' (Cag.); kalumpít (Bat.); malagábi (Min.); magtalísi, magtalísai (Mas., Cota., Zambo.); mantabíg (Zambo.); pansáket (Tag.); SÁCAT (Bat., Zam., Pamp., Tar., Riz., Lag.); samondó (Pal.); sulo'-súlo' (Zam.); tágit (Pal.).

Wood moderately heavy; moderately hard to hard; sapwood rather large (5 centimeters or more), yellowish when fresh, often turning deep yellow in drying, not very sharply marked off from heartwood; heartwood yellowish brown; grain generally straight, sometimes slightly crossed and curly; texture fairly fine, smooth; colors water yellow; seasons well; easy to work. Durability III.

Structure.—Pith rays fine to medium, distinct; pores medium sized, scattered, but often distinctly more numerous in inner part of ring; soft tissue not conspicuous, in small irregular patches surrounding and often connecting the pores and forming very irregular broken concentric lines; growth rings marked by a narrow belt of dense tissue.

Uses.—Same as talisay.

Supply.—Limited.

Prices.—About ₱80 to ₱100 per M.

T. oöcarpa Merr. TALÍSAY-GÚBAT.

A tall, straight tree, up to 90 centimeters in diameter; reported from: I. N., Cag., Pang., Tar., Zam., Pamp., Bat., Riz., Lag., Batg., Tay., Cam., Min., Sam., Neg., Cap., Ant.

Local names.—Alilem (Cag.); bangkaláuag (Ant.); dalinsái (Cam.); dalinsí' (Tay.); dalinsín (Alb.); hákit (Zam.); kalumpít (Tay.); kalautít (I. N.); magtalísai (Neg., Agus.); malagábi (Min.); malapútat (Riz.); paang-balíuis (Batg.); sákat (Cag., Bat., Lag.); TALÍSAY-GÚBAT (Bat., Min.).

Wood moderately heavy; moderately hard; sapwood light brown, in old seasoned wood scarcely distinct from heartwood; heartwood dark brown; grain straight; texture coarse; very similar to talisay, but with larger pores and of somewhat darker color.

Structure.—Pith rays medium sized, but indistinct, being hardly visible to naked eye; pores large, numerous, evenly scattered, majority smoothly oval, often partitioned; soft tissue forming rather conspicuous rings about pores and very irregular broken and wavy concentric lines; growth rings sometimes marked by a rather distinct belt of dense tisue.

Uses.—Same as talisay.

Supply.—Limited.

Prices.—Very rarely comes to Manila market; would be sold as talisay or calumpit, or else with miscellaneous lumber.

T. pellucida Presl DALINSÍ.

A tall, straight tree, up to 100 centimeters in diameter; reported from: Cag., Pang., Tar., Pamp., Zam., Riz., Lag., Tay., Sam., Cap., Pal.

Local names.—Aritongtóng (Zam., Pang.); DALINSÍ' (Tay.); duláuen (Cag.); hákit (Zam.); kalautít (Tar.); manáong (Pang.); sákat, sáket (Pang., Zam., Lag.); súlo'-súlo' (Pamp.); upung-úpung (Sam.).

Wood moderately hard; moderately heavy; sapwood light brown, not sharply distinguished from heartwood; heartwood brown or reddish brown, often with lighter and darker streaks; grain somewhat crossed and curly; texture fairly fine, glossy; not difficult to work. Durability III; not attacked by beetles.

Structure.—Pith rays medium sized; pores medium sized to large, scattered, often partitioned; soft tissue sometimes scant, sometimes forming many very irregular, broken concentric lines; growth rings sometimes inconspicuous, sometimes fairly distinctly marked by a belt of denser tissue.

Uses, supply and prices.—Same as talisay.

T. quadrialata Merr.[1] TÓOG.

A tall, straight tree up to 100 centimeters in diameter, except Agusan, where it reaches 200 centimeters or more; reported from Sor., Mas., Sam., Ley., Agus.

Local names.—Bagulañgog (Sam.); gúog (Mas.); kapúlau (Cebu); lumáñgog (Ley.); magtalísai (Mas.); túog or TÓOG (Sor., Mas., Sam., Ley., Agus.); tohog (Agus.).

Wood moderately heavy; moderately hard; sapwood large (4 to 8 or 10 centimeters), whitish, rather sharply marked off from heartwood; heart-

[1] Since this was written, Mr. E. D. Merrill, of the Bureau of Science, has received flowering specimens of tóog and informs me that it does not belong to this family, but to the Lecythidaceae (Putat family) and that, when the transfer is published, the scientific name of tóog will be *Petersianthus quadrialatus* Merr.

wood bright reddish brown, frequently with broad lighter and darker belts; grain fairly straight, sometimes a little crossed; texture rather coarse; liable to warp and check if not carefully seasoned, not difficult to work. Durability III; even sapwood not attacked by beetles.

Structure.—Pith rays numerous, fine to broad, very irregular in thickness and spacing; pores medium to large, oval, many with 1 to 3 partitions, scattered; soft tissue scattered, forming rather conspicuous rings about pores and irregular transverse lines between rays; alternating bands of lighter and darker color give the appearance of growth rings, but these are little, if at all, marked in the structure.

Uses.—Same as talisay.

Supply.—Abundant in Agusan River Valley, elsewhere common but not abundant.

Prices.—Has never been brought to Manila market, but should bring at least ₱80 to ₱100 per M.

T. blancoi Merr., KALAMANSÁKAT, is reported only from Beng., N. E., and Riz.; in color, mechanical properties, and structure the wood is practically identical with malakalumpit.

T. curranii Merr. is known from one specimen from Laguna; no wood specimen is known.

T. darlingii Merr. is known only from Isa., Tay., Cam., and Sam.; the wood is hard, moderately heavy, brown and in structure resembles sacat.

MYRTACEAE.

[Macaasim family.]

A large family, containing the well-known guava, mancono (the "ironwood" of the Philippines), and the macaasims, the latter the product of a number of species of the genus *Eugenia*, which, with the exception of *Ficus*, is probably the largest and most widely distributed genus of trees in the Archipelago; the genus *Eucalyptus*, which plays so important a part in Australia, is represented by only a single species.

Genus EUCALYPTUS.

E. naudiniana F. v. Muell. AMAMANÍT.

A tall, straight tree, up to 200 centimeters or more in diameter; reported only from Cotabato and Zamboanga, with local names diñglás and AMAMANÍT.

Wood soft to moderately hard, rather brittle; light; sapwood pale red, not quite sharply marked off from heartwood; heartwood light red; grain distinctly crossed in broad belts, giving a conspicuous ribbon when quarter-sawn; texture rather coarse, but glossy; in general appearance much like a light, bright red lauan; seems to season well; easy to work. Durability not well known, but fallen trees, apparently down since a number of years, reported to be quite sound.

Structure.—Pith rays numerous, small, indistinct; pores numerous, medium sized to large, arranged in crowded, wavy, branching diagonal lines, many with glistening, frothy deposits (tyloses); soft tissue inconspicuous; growth rings none or very ill defined.

Uses.—Little or nothing is known of local use as the tree occurs only in a wild and thinly inhabited region; would make very pretty interior finish and furniture wood. Has been used at San Ramon, Zamboanga, for piling and proven durable.

Supply and prices.—Has come into the market only with mixed lots of red woods passing as red lauan.

Genus EUGENIA.

Over 150 species known, ranging from small shrubs to tall trees up to 120 centimeters or more in diameter. There is considerable variation of texture and color, but the woods of the larger species found in the markets under the names of macaasim and malaruhat are fairly uniform in general appearance and structure.

A very great number of local names is on record, of which many are apparently of very limited range while others are applied also to entirely different trees; the following is a list of the names that are applied most commonly to species of *Eugenia:*

Local names.—Balakbák or barakbák (N. Luz.); bali'gáng, mali'gáng (S. Luz.); bilólo, binólo, BINOLÓAN (S. Luz., Sam., Ley.); bohókan (S. Luz.); DÚHAT (C. Luz.); hagís, malahagís, etc., (S. Luz.); igót, malaigót, etc. (S. Luz.); lipóte (C. Luz.); longbói or lumbói (extreme N. & S. provinces of Luz., Bis. islands); kalobkób, karobkób, karogkóg, kayogkóg, or KALUBKÚB, etc. (C. and S. Luz., Sam., Ley.); MACAÁSIM, MALARÚHAT (C. Luz.; these two are practically the only names well known in Manila lumber yards); paít, PAITÁN (I. N., I. S., Bat., Batg., Lag., Tay., Cam.); pan͠gó' or pan͠gót, pan͠gugót, pan͠gugók (Cag.); PANGLONGBÓÍEN (I. N., I. S., Cag., N. E., Tar., Pang.); sambulauán, tambulauán (S. Luz.); tambís, bago-tambís, etc. (S. Luz., Sam., Ley. and other Bis. islands); tampúi, MALA-TAMPÚI, etc. (same).

Wood moderately hard to hard; moderately heavy to heavy, specific gravity 0.705 (Foxworthy), 0.717 (Gardner), 0.646 to 0.896 (Puigdulles); sapwood 2 to 8 centimeters thick, grayish or pale brown, often with yellowish or greenish tints, rather sharply distinguished from heartwood; heartwood generally grayish brown, often with greenish, yellowish or reddish tinge; with distinct acid odor when fresh and blackens polished tools; grain somewhat crossed and often wavy, forming a regular, wavy, diagonal ribbon when quarter-sawn; texture fine, even, but dull; rather difficult to season; not difficult to work, but dulls edge tools rather rapidly. Durability II; even sapwood rarely attacked by beetles.

Structure.—Pith rays fine or very fine, indistinct; pores small to medium sized, scattered; soft tissue in numerous, fine, wavy, irregular and interrupted tangential lines surrounding and connecting pores; growth rings none or very ill defined. (*See* Pl. IX, fig. 65.)

Uses.—Ship, bridge, and wharf building; piles; poles; ties; posts; beams, joists, rafters, and studs; flooring; window sills; siding; furniture and cabinetwork; agricultural implements; tool handles; musical instruments (heavy parts such as bases of harps, necks of guitars); rice mortars and other household implements.

Supply and prices.—Though very widely distributed, the trees of the genus *Eugenia* are always scattered; none of the large operators have so far attempted to keep the wood separate, but market it with miscellaneous lumber; a limited supply is almost always to be found among the small yards in Manila, which buy rafts or loads of logs from the provinces; good boards or dimension stuff bring from ₱120 to ₱160 per M.

The following are among the most important species of *Eugenia;* it must be remembered that probably a great many other species are occasionally cut.

E. benthami A. Gray. (Pl. IX, fig. 65.)[1] MACAÁSIM.

A tree up to 75 centimeters in diameter; reported from: Beng., Bat., Riz., Lag., Tay., Cam., Min.

Local names.—Aráhan (Cam.); dulítan (Riz.); kalubkúb (Bat.); makaásim, or MACAÁSIM, malarúhat (Tay., Cam., Min.).

E. brevistylis C. B. Rob. SAGÍMSÍM.

A tree up to 100 centimeters in diameter; reported from: Isa., Tay., Sur., Din., Tinago, Agus., Mis., Lan., Cota., Zambo.

Local names.—Kólis (Tay.); lagi-lagí (Sur.); malarúhat (Mis., Zambo.); putik-putik (Zambo.); SAGIMSÍM (Cota.).

E. calubcob C. B. Rob. KALUBKÚB.

A tree up to 90 centimeters in diameter; reported from: Bab., Bats., I. S., Beng., N. V., N. E., Un., Tar., Pamp., Bul., Bat., Riz., Lag., Man., Batg., Tay., Cam., Sam., Min., Cebu, Neg., Guim., Bal.

Local names.—Adáng (Isa.); barakbák (I. S., Un.); makópa (Lag.); malakópa (Neg.); malarúhat (N. E., Min.); panglumbóien (Tar.); tampúi (Bul., Tay.); two-thirds of all specimens with name KALUBKÚB, karogkóg, etc.

E. clausa C. B. Rob. PANGLONGBÓIEN.

A tree up to 100 centimeters in diameter; reported from: Cag., I. S., Isa., Riz., Min., Neg., Pal.

Local names.—Dakúg (I. S.); lubagán (Isa.); malarúhat (Riz., Cota.?); PANGLONGBÓIEN (Cag., I. S.).

E. claviflora Roxb. KURASÁM.

A tree up to 80 centimeters in diameter; reported from: Bab., Cag., I. S., N. E., Zam., Bat., Lag., Cam., Alb., Sam., Pal.

Local names.—Bulagsóg (Alb.); gamatúlai (Cag.); kaitatanág (Lag.); kara (Bat.); KURASÁM (Cag.); malarúhat na putí (Bat.); maramatám (Cag.); panglongbóien (Cag., I. S.); pañgó' (Cag.); tináan (Cam.).

E. costulata C. B. Rob. PAITÁN.

A tree up to 80 centimeters in diameter; reported from: Pang., Bat., Riz., Tay.

Local names.—Bayakbák (Pang.); malakná' (Riz.); PAITÁN (Pang.); tianúg (Bat.).

E. glaucicalyx Merr. MARIÍG.

A tree up to 80 centimeters in diameter; reported from: Bat., Lag., Cul., Pal.

Local names.—Kalaum (Cul.); malarúhat (Lag.); MARIÍG (Bat.).

E. jambolana Lam. DÚHAT.

A tree up to 90 centimeters in diameter; reported from: I. N., I. S., Cag., Abra, Lep., N. E., Un., Zam., Bul., Riz., Un., Lag., Batg., Min., Lubang, Cebu, Neg., Cap., Guim., Mis., Pal.

The wide distribution of this species is undoubtedly due to its being frequently cultivated for its fruit, which in size, color, and flavor resembles a black cherry.

Local names.—Beside DÚHAT, only longbói, or lumbói.

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[1] This figure is from a species (*Eugenia longiflora* F.-Vill) not included in the following descriptions, but which well represents the structure of the woods of the genus.

E. mananquil Blco. MANANGKÍL.

A tree up to 120 centimeters in diameter; reported from: I. S., Pang., Pam., Zam., Riz., Lag., Cav., Batg., Tay., Cam., Alb., Sor., Min., Ley., Mis., Lan., Cota., Dav.

Local names.—Bagabág (Pamp.); bidbíd (Cam.); buabúa (Min.); bungkúlan (Lag.); kagokó' (Ley., Lan., Cota.); malahagís (Sor.); malarúhat (Zam., Lag.); MANANGKÍL (Blanco's Flora); midbíd (Tay.); muñgilkíl (Min.); panglongbóien, kopakópa (I. S.); pasóso (Riz.); tambís (Cota).

E. saligna C. B. Rob. BINOLÓAN.

A tree up to 80 centimeters in diameter; reported from: Cag., Palaui, Beng., Pamp., Zam., Bat., Riz., Lag., Tay., Batg., Alb., Ley., Mar., Neg., Mis., Bas.

Local names.—BINOLÓAN or binlóan (Ley); bohókan (Alb.); lubég (Cag.); mabayáon (Tar.); malarúhat (Bat., Lag.); ñgarít (Palaui); tagilumbói (Neg.); talamitám (Batg.).

E. similis Merr. MALARÚHAT.

A tree up to 75 centimeters in diameter; reported from: I. N., N. E., Pang., Pamp., Zam., Bat., Lag., Tay., Min., Mas., Sur., Cota.

Local names.—Aráng (Min.); makaásim (Tay.); magakombó (Dav.); MALARÚHAT (N. E., Bat., Min.); mayaúban (Sur.); paitán (Zam., Pamp.); panglongbóien (I. N.).

E. xanthophylla C. B. Rob. MALATAMPÚI.

A tree up to 90 centimeters in diameter; reported from: Cag., I. S., Abra, N. E., Pang., Bul., Zam., Riz., Lag., Tay., Cam., Sor., Min., Neg.

Local names.—Apiníg, kapiníg (Sor.); balakbák (Zam.); barakbák (N. E.); bislót (Riz.); kayokó' and similar forms (Tay.); MALATAMPÚI (Occ. Neg.); malayambo (Tay.); tampúi (Min.).

Genus PSIDIUM.

P. guajava L. GUAVA or BAYÁBAS.

The guava, a small tree, reaching 30 centimeters in diameter, introduced from tropical America, now thoroughly naturalized, of almost universal distribution through the Islands and generally known by various corrupt forms of the Spanish *guayabas*.

Wood hard and tough; heavy, specific gravity 0.827 (Puigdulles); sapwood pale brown, merging gradually into slightly darker heartwood; grain straight or slightly crossed and sometimes wavy; texture very fine and smooth; liable to warp in seasoning; fairly easy to work and takes a very smooth surface under sharp tools. Durability III.

Uses.—Household and agricultural implements, ax and other tool handless; treenails; pestles; piston rings for water cylinders of small feed pumps; posts of small houses; fence posts and stakes; yokes; charcoal.

Supply.—Rarely found larger than in fence-post size and never used as saw timber. Except as firewood or charcoal wood and as fence stakes, all of which are sold by count or stacked, it has no commercial price. For the various other uses mentioned, it is generally cut in waste lands or second-growth woods ("párang") by the man who needs the article in question.

Genus TRISTANIA.

A genus of small to medium sized trees of three or four species; the wood of all species is practically identical and the same names are given almost indifferently to the various species in different regions.

Local names.—Ádios (Cag.); anigád (Sur.); bungló (Cag.); buság (Sam.); diñglás (Pol.); hublás (Neg.); MALABAYÁBAS, i. e., "false guava," from the resemblance of the very smooth bark to that of bayabas (*Psidium guajava*), (Bat., Tay., Cam.); malumbayábas (Zambo., Bas.); malapíga Tay.); TÁBA (Zambo.); TÍGA (Tay., Cam., Alb., Sam., Ley.); tinadán (Abra).

Wood very hard; very heavy; sapwood 1 to 3 centimeters thick, light brown, merging rather gradually into heartwood; heartwood dark brown, turning almost black after long exposure; grain slightly crossed; texture dense, fine, glossy; seasons without much checking, but needs to be carefully piled to prevent warping; hard to work, but does not dull tools specially and is not difficult to surface. Durability at least II, more probably I; even sapwood rarely if ever attacked by insects.

Structure.—Pith rays numerous, very fine, indistinct, sometimes whitish; pores small to medium sized, scattered or in short, straight or wavy tangential lines, the majority filled with light brownish tyloses, the remainder with chalk-white deposits; soft tissue very inconspicuous; no growth rings.

Uses.—Piles; bridge and wharf construction; posts; window sills; beams, joists, rafters; ties; tool handles and wooden tools; cabinetwork.

Supply and prices.—Not selected systematically for cutting, coming into market only occasionally; sometimes ignorantly or fraudulently substituted for mancono, which, in hardness, weight, texture, and color, it rather closely resembles, but otherwise sawn into dimension stuff and sold with mixed lots of hard and heavy construction timbers at prices ranging from ₱70 to ₱130 per M.

Following are the best-known species of *Tristania:*

T. decorticata Merr. MALABAYÁBAS.

A tree up to 80 centimeters in diameter; generally found on low ridges near the coast; reported from: Cag., Bat., Tay., Pol., Cam., Alb.

T. littoralis Merr. TÁBA.

A tree up to 40 centimeters or more in diameter, found on the coast or along inner edge of mangrove swamps; reported only from Zamboanga and Basilan.

T. sp. TÍGA.

A tree up to 60 centimeters in diameter, in the same forest types as preceding; reported from: Tay., Cam., Sam., Ley., Neg.

Genus XANTHOSTEMON.

X. verdugonianus Naves. (Pl. IX, fig. 66.) MANCONO.[1]

A tree up to 115 centimeters in diameter, but with a generally very short and irregular trunk; many trees branch within 1 or 2 meters of the ground and the longest clear trunk reported is 10 meters.

Local names.—Malapíga (Cul.); magkonó or mangkonó (Ley., Sur., Din., Agus.); tamuláuan (Ley.); tíga (Sib.); "Philippine ironwood," "Philippine lignum-vitae," "palo de hierro."

Wood very hard; very heavy, specific gravity 1.236 (Foxworthy), 1.296 (Puigdulles); sapwood 1 to 2 centimeters thick, pale reddish, sharply distinguished from heartwood; heartwood yellowish brown, turning to dark bronze color or nearly black with age; grain always crossed, frequently curly and twisted; texture extremely fine and dense, so that the raw

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[1] Pronounced mang-konó; the Spanish spelling of the Surigao name.

wood (without oil or polish) can be burnished almost like metal; seasons without warping much, but large logs have often several radial heart cracks, and fresh sawn pieces check superficially, but not deeply; very difficult to work. Durability I; probably easily the first among Philippine woods in this respect; posts 40 years old have 1 centimeter of sapwood decayed at surface of ground, and salt-water piling over 20 years old is attacked by teredo to about the same extent.

Structure.—Pith rays very fine, indistinct; pores few, very small, scattered; soft tissue scarcely noticeable; growth rings absent or very indistinctly marked.

Uses.—Posts; piles; tool handles and other wooden tool parts; bowling balls; dumb-bells; paper weights and other desk novelties; pulleys, rollers, sheaves, bearings, saw-guide blocks, etc.

Supply and prices.—Scarce except in Surigao and Agusan, where it is estimated that there are 3,000,000 cubic feet of standing timber 30 to 90 centimeters in diameter; logs can be obtained delivered on the beach at Surigao at ₱1 to ₱1.50 per cubic foot, but it is estimated that by a systematic and extensive logging operation they could be put on shipboard for ₱0.22 per cubic foot.

ARALIACEAE.

[Malapapaya family.]

A family containing, in the Philippines, only a single timber tree.

Genus POLYSCIAS.

P. nodosa Seem. (Pl. IX, fig. 67.) MALAPAPÁYA.

A tall, slender tree, with few or no branches, up to 50 or 60 centimeters in diameter; reported from: Beng., Bul., Pang., Bat., Riz., Lag., Tay., Cam., Siq., Sur., Bas., Pal.

Local names.—Biasbías (Tag., Bis.); bon͠glín, bun͠glín, (Tag., Bis.); guyonggúyong (Bat.); hagdán-anák (Cebu); MALAPAPÁYA (Riz., Pamp., Bat., Lag., Pal.); malasapsáp (Pamp.); manománo (Bas.); túkud-lán͠git (Bat.).

Wood soft; light; whitish when fresh cut, but turning to a pale pinkish or brownish white in drying and very liable to bluing if not rapidly seasoned; no distinct sap and heartwood; of fine texture and very straight grain; very easy to work. Durability IV.

Structure.—Pith rays medium sized to moderately broad; pores medium sized, evenly scattered; soft tissue scattered, not at all conspicuous; growth rings sometimes absent, sometimes marked by narrow more or less porous belts.

Uses.—Matches and match boxes; light construction and cheap boxes; light household implements; fish-net floats.

Supply.—Limited.

Prices.—Not sawn; match logs about ₱9 per cubic meter.

ALANGIACEAE.

[Malatapai family.]

A family containing but one genus, that furnishes two quite distinct woods, neither one of any special importance, but one, malatapai, of interest for its beauty as a cabinet wood.

Genus ALANGIUM.

A. longiflorum Merr. MALATAPÁI.

A tree up to 50 centimeters in diameter, but with a short and often irregular bole; reported from: Cag., Bat., Lag., Tay., Cam., Sam., Ley., Cota., Pal.

Local names.—Apítan (Cag.); bun͠glás (Cam.); busáhin (Tay.); guntapái (Cota.); MALATAPÁI and malakapái (Lag., Tay., Cam.).

Wood heavy; moderately hard; sapwood large, bright yellow, sharply distinguished from heartwood; heartwood coffee brown, of rather fine and very even texture, with a faint pleasant odor; in color and texture resembles pagatpat, but is finer and glossier; seasons well and works easily, taking a very smooth surface under a sharp tool. Durability II; even sapwood rarely attacked by insects.

Structure.—Pith rays fine, numerous, many whitish; numerous, fine, somewhat irregular concentric lines of soft tissue, similar to those of the gutta-percha and ebony families; pores small to very small, the larger ones few and scattered, the smaller numerous with a tendency to form irregular radial strings; white deposits in some pores and in concentric lines; end of growth ring marked by a narrow, distinct line of dark, dense wood.

Uses.—Canes, scabbards, carving, furniture, cabinetwork; used locally for small house-posts.

Supply.—Limited.

A. brachyanthum Merr.

A tree 30 centimeters in diameter; reported only from Tayabas, with local name malatapái. Wood identical with above.

A. salviifolium Wang. GUNTAPÁI.

A tree 30 centimeters or more in diameter reported from Cota., Lan., Bas., with above local name. Wood identical with above.

A. meyeri Merr. PUTÍAN.

A tree up to 50 centimeters in diameter; reported from: Cag., I. S., Amb., Batg., Lag., Tay., Cam., Pol., Min., Sam., Neg., Cap., Agus., Bas.

Local names.—An͠gátuan (Cag.); liembán (I. S.); malakapái, maragabúlo (Tay.); PUTÍAN (Lag., Min., Neg., Cap.); páang-darága (Cam.); talipugúd (Cag.).

Wood heavy, moderately hard; sapwood and heartwood not distinct, so far as known; dull, yellowish white, subject to bluing or sap stain; of coarser texture than malatapai. Durability III (?).

Structure.—Pith rays rather coarse, conspicuous, very numerous, crowded, bending around pores or groups of pores; transverse lines of soft tissue between rays numerous and conspicuous; pores numerous, fairly even in size, scattered or in radial strings of 3 to 8 or 10; growth rings irregular and ill defined. In longitudinal sections, the pores often show as glistening lines. Both in general appearance and in structure, the wood resembles malapinggan and banaui.

Uses.—Little used on account of lack of durability; recommended for foundation piling for its strength and shape.

Supply.—Widely distributed, but scattering.

Prices.—Rarely brought to Manila market; if sawn, would sell with cheap miscellaneous lumber.

SAPOTACEAE.

[Betis family.]

A family containing a number of large timber trees with woods varying widely in mechanical properties, but of very uniform structure, resembling that of the *Ebenaceae.* Pith rays numerous and fine; pores small or medium sized, arranged in straight or wavy radial lines, the lines often in echelon or "staggered;" soft tissue forming numerous fine, generally slightly wavy concentric lines; growth rings indistinct or absent; heartwood always red except the genus *Sideroxylon,* in which it is whitish or pale yellow; most of the woods give a very fine white lather when briskly rubbed with water or saliva.

Genus BASSIA.

A genus of about eight species, of which only two are well known, the others being much rarer and their wood little or not at all known.

B. betis Merr. (*Illipe betis* Merr.). (Pl. IX, fig. 68.). BÉTIS.

A tree up to 100 centimeters in diameter; reported from: Cag., Isa., Riz., Tay., Cam.; a tree called manilig in Cotabato has been botanically determined as betis, but the wood is much lighter and softer than that from Luzon.

Local names.—Banítis (Cam.); BÉTIS (Riz., Tay., Cam.,) manilig (Cota.); pásak (Man. lumberyards); piáñga or piáñgan (Cag., Isa.).

Wood hard; heavy, specific gravity 0.728 to 0.856 (Gardner); sapwood 2 to 4 centimeters thick, pale reddish, rather sharply distinguished from heartwood; heartwood deep reddish brown; grain slightly crossed; texture dense, fairly smooth, but not glossy; distinct bitter taste; lathers freely; seasons well in boards, but large timbers are liable to check internally; hard to saw, but not otherwise difficult to work. Durability I; heartwood rarely attacked even by termites and eaten only very slowly by teredo, and even sapwood not rapidly attacked by fungi.

Structure.—Pith rays very fine; pores small, in irregular, oblique radial lines, sometimes with yellowish deposits; soft tissue in numerous concentric lines; growth rings indistinct or absent.

Uses.—Wharf, bridge, and ship building; posts; foundation sills; turned and shaped tool handles; ties; paving blocks.

Supply.—Very limited.

Prices.—One hundred and seventy pesos to ₱200.00 per M.

B. ramiflora Merr. (*Illipe ramiflora* Merr.). BANÍTI.

A tree up to 60 centimeters in diameter; reported from: Pang., Zam., Bul., Lag., Tay., Min., Ley., Zambo.

Local names.—Amúgis (Bul.); BANÍTI' (Bat.); buluán (Zam.); gatasgátas (Ley.); kalamansánai (Lag.); silang-batú (Lag.); tañgíli (Bul., Tay., Min.); also given many of the same names as the natos (*Palaqium* spp.), with which the wood is confused in the markets.

Wood soft; light; sapwood pale grayish red, rather sharply distinguished from heartwood; heartwood dull red; grain straight; texture rather coarse, with conspicuous pores; seasons very well; very easy to work. Durability IV, but seasoned timber very rarely attacked by beetles, though the living tree is often badly riddled by a very large borer.

Structure.—Pith rays fine, inconspicuous; pores small, in very irregular radial strings; soft tissue as in betis.

Uses.—Same as the natos, see p. 196.

Supply and prices.—Probably much less abundant than the natos and, in the market practically unknown, being sold as nato, manicnic, etc., or mixed with red lauans and other miscellaneous lumber.

Genus MIMUSOPS.

A genus of two species, of which one, *M. calophylloides* Merr., has been reported only from Surigao, where it is called duyokdúyok; the wood appears to be identical with bansalagin, except that it seems to be, as a rule, lighter in color.

M. elengi L. BANSALAGIN.

A tree up to to 80 centimeters in diameter; reported from: Palaui, Cag., I. S., N. E., Un., Pamp., Zam., Bat., Bul., Man., Tay., Cam., Min., Amb., Mas., Neg., Sib., Tic., Cota., Zambo., Cul., Pal., Sulu Arch.

Local names.—Anosép (Pamp.); BANSALÁGIN or (in Bikol and Bisaya provinces) often bansalágon (Man., Bat., Tay., Cam., Min., Mas., Tic., Neg., Sib., Cota., Zambo., Pal.); basal (Min.); kabikí (Man., Cam.); ligáian (Zambo., Sulu Arch.); gatásan (N. E.); gasátan (I. S.); pagpágan, papágan, pappágan (Cag.); pásak (N. E., Tar., Pamp., Man. lumberyards); tagátoi (Bul.); talipópo (Cul.).

Wood very hard; heavy to very heavy, specific gravity 0.784 to 0.905 (Gardner); sapwood very pale red, sharply marked off from heartwood; heartwood rich deep red; grain straight; distinct bitter taste; texture denser and finer than in betis, taking a glossy surface under sharp tools; liable to split badly if not very carefully seasoned; hard to saw, but not otherwise difficult to work. Durability I; sapwood somewhat inferior to heartwood.

Structure.—Very similar to betis (*Bassia betis*), but all elements finer; cross section, like all other surfaces, glossier than betis when cut with a sharp tool.

Uses.—Much the same as betis; also a favorite for ship's wheels, marline spikes, fine tool handles, etc., where both for looks and wearing qualities, a dense, fine wood is desired.

Supply.—Limited; formerly well known in Manila market, but at present rather scarce.

Prices.—One hundred and fifty pesos to ₱170 per M.

Genus PALAQUIUM.

A genus of about 25 species, of which one or more are reported from practically every island and province in the Archipelago; medium sized to very large trees, ranging up to 150 centimeters in diameter, and with tall, beautifully straight trunks. The wood of all species, except for some differences in color, weight, and hardness, is practically identical; in the Manila market it is known as nato, manicnic, malacmalac, dulitan and "amugis corriente." The local names in various regions are applied to all species almost indifferently.

Local names.—Akátan (Isa.); alaká' (Min.); ALAKÁAK (Pamp., Bat., Riz., Lag., Tay., Min.); apaka-paká' (Isa.); araká' (Cag.); baníti' (Bat.); basóg (I. N.); bayátis (Cam.); bokbók (Bat., Sor.); bulan-bulán (Guim.); dapagan (Un.); DULÍTAN (Lag., Tay., Cam.); gañgáuan (Min., Mas.); gasátan (I. N., I. S.); gatásan (Cag., I. S., Pang.); gattátan (N. E.); kalapía, KALIPÁYA (Zambo.); lako-láko (Guim.); lapat (Min.); ligaán (Cota.); MALACMÁLAC (Zam.); MALIKMÍK, mamungkalión (Lag.); MA-

NICNÍC (N. E., Zam., Bat., Lag.); manipníp (Bat.); NÁTO' with various qualifying words (Bats., Bat., Lag., Cam., Alb., Min., Mas., Neg.); manogtalísai (Cap.); mayusip (Min.); opong-ópong (Cam.); pakarán (Pang.); palakpálak or palokpálok (N. E., Pang., Tar., Zam., Bat., Pamp., Bul., Man., Lag.); salikút (Agus.); tadkán (Cam.); TAGÁTOI (Zam., Bat.); tagkán (Sur.); takarán (Pang.); tañgíli, tañgíling-kompól, tañgíling-palokpálok (Bul.); tingkayád (Riz.); tipurús (Cota.); yambán-aromúi (Zam.).

Wood soft to moderately hard; light to moderately heavy; sapwood 2 to 5 centimeters thick, pale red, in large trees rather sharply marked off from heartwood; heartwood light red to dull reddish brown; some specimens lather quite freely, at least when fresh; grain straight or slightly crossed, sometimes with a regular wave forming a diagonal ribbon in radial sections; texture fine, smooth, taking an almost glossy finish under sharp tools; seasons very well; very easy to work. Durability IV, but very rarely attacked by beetles.

Structure.—Pith rays fine, indistinct; pores small to medium sized, in longer or shorter radial rows, seldom single or in groups; soft tissue in numerous, fine, concentric lines. (Plate IX, fig. 69.)

Uses.—All uses of various lauans; a favorite for cheap cigar boxes; also, on account of its cheapness, ease of working and freedom from warping and attacks of beetles, a favorite among Filipino and Chinese cabinet-workers for bottoms and sides of drawers, shelves and backs of sideboards, dressers, wardrobes, etc.; among such trades known as "amugis corriente" as distinguished from true amugis, which is called "amugis perfecto."

Supply and prices.—Not as abundant as the lauans, but perhaps even more universally distributed than any single one of these; always present among stock of logs in Manila yards; by larger operators mixed with lauans and with other soft miscellaneous red woods. When sold under any of the names properly belonging to it, or as "amugis corriente," brings slightly higher prices than miscellaneous lumber.

The following are the largest and most widely distributed species of *Palaquium:*

P. ahernianum Merr. KALIPÁYA.

A tree up to 50 centimeters or more in diameter; reported from Agus., Zambo.; probably found in other provinces of Mindanao.

P. cuneatum Vid. MALIKMÍK.

A tree up to 100 centimeters in diameter; reported from: I. S., Zam., Pamp., Bul., Riz., Min., Cebu, Guim.

P. foxworthyi Merr. TAGÁTOI.

A tree up to 60 centimeters or more in diameter; reported from: Pang., Zam., Bat., Lag., Tay.

P. gigantifolium Merr. ALAKÁAK.

A tree up to 50 centimeters or more in diameter; reported from: Beng., Lag., Tay., Cam., Min., Sur.

P. luzoniense Vid. (Pl. IX, fig. 69.)[1] NÁTO.

A tree up to 150 centimeters in diameter; reported from: Cag., I. S., Abra, Pang., Zam., Bat., Pamp., Bul., Riz., Tay., Min., Mas., Sib., Guim.

[1] This figure is from a species (*P. lanceolatum* Blco.) not included among those here described, but well represents the structure of all the woods of the genus.

P. merrillii Dubard DULÍTAN.

A tree up to 80 centimeters in diameter; reported from: N. E., Bat., Lag., Tay., Cam., Min., Guim.

P. philippense C. B. Rob. MALACMÁLAC.

A tree up to 120 centimeters in diameter; reported from: Cag., Isa., N. E., Pang., Un., Tar., Zam., Bat., Pamp., Bul., Riz., Lag., Man., Batg., Tay., Cam., Alb., Min., Cap., Neg.

P. tenuipetiolatum Merr. MANICNÍC.

A tree up to 130 centimeters in diameter; reported from: Cag., Isa., Pang., Zam., Bat., Lag., Tay., Min., Mas., Mis.

Genus SIDEROXYLON.

A genus of about 18 species; small to large trees of the same habit of growth as *Palaquium,* though not as large.

Though the woods are generally lumped together under the name of the white natos, they vary considerably in character, especially in hardness, as well as somewhat in structure.

The following are the largest and most widely distributed species of *Sideroxylon:*

S. duclitan Blco. DUKLÍTAN.

A tree up to 100 centimeters in diameter; reported from: Cag., Bat., Man., Lag., Batg., Tay., Cam., Min., Cota., Zambo.

Local names.—Bangkalandí (Bat.); DUKLÍTAN (Bat.); dulítan (Lag.); malaióhot (Min.); malamanggá (Bat.); náto' (Tay.); ririáu (Cam.).

Wood soft to moderately hard; light to moderately heavy; no distinct sapwood and heartwood; creamy white, darkening very slightly on exposure, but frequently bluing very badly if not quickly seasoned; grain very straight; texture fine and dense, but pores conspicuous on all longitudinal sections, the very long radial lines of pores forming an attractive pattern on radial sections; except for bluing, seasons very well; very easy to work. Durability poor and sometimes wormy when cut, but sawn and seasoned wood very rarely attacked by borers.

Structure.—Pith rays numerous, fine, wavy, often bending around pores; pores small, in long, somewhat irregular and interrupted radial strings, lines of soft tissue numerous, but faint, irregular, and interrupted.

Uses.—Used locally for cheap and temporary construction; household implements; small carved and turned articles; often used instead of lanete, for which it is a cheap, easily worked, serviceable, and pretty substitute; cheap bolo and knife handles; wooden-shoe soles; would make an excellent wood for pyrography panels.

Supply and prices.—Supply limited; in the Manila market this (and perhaps other species of the genus) is found rarely in logs, occasionally in lots of cheap miscellaneous lumber selling at about ₱40 per M. Perfectly clear (that is, unstained) lots might command slightly higher prices as a lanete substitute.

S. ferrugineum Hook. & Arn. MANGKÁS.

A tree up to 60 centimeters in diameter; reported from: Cag., Tay., Cam., Alb., Min., Bur., Tab., Sam., Neg., Bas., Sulu Arch.

Local names.—Kalamuñgús (Tay.); limes (Cag.); mamangkás (Bur.); MANGKÁS (Sibutu); marumangkás na laláki (N. Tay.); nanka-nanká' (Bas.); panási, (Cam.); tabagíd (Neg.).

Wood hard; heavy; distinctly yellow; grain straight; texture dense and smooth; seasons well, though somewhat liable to splitting at ends; not difficult to work.

Structure.—Pith rays very fine; pores very small, in long wavy radial rows; concentric lines of soft tissue numerous, continuous, more distinct than in other species. In a smooth cross section, the feature most conspicuous to the naked eye is the radial lines of pores.

Uses.—Very little is known of local uses; a very pretty ornamental wood for cabinetwork and carved or turned articles.

Supply.—Apparently scarce; rarely found among miscellaneous lumber.

Prices.—Unknown in the markets; would sell with the cheaper miscellaneous lumber.

S. luzoniense Merr. BANOKBÓK.

A tree up to 50 centimeters in diameter; reported from: Cag., Pamp., Riz., Batg., Cam., Lub., Tic., Bas.

Local names.—Amangkás (Tic.); BANOKBÓK (Cam.); malasambóng-batú (Riz.).

Wood very similar to preceding; apparently still scarcer.

S. macranthum Merr. WHITE NÁTO.

A tree up to 80 centimeters or more in diameter; reported from: Cag., N. E., Bat., Tay., Cam., Min., Tab., Cota.

Local names.—Baíd (Tab.); batun (Min.); barotól, barúto (Cag.); botgó (Cam.); NÁTO' PUTÍ,' or WHITE NÁTO (Tay.); putían (Man. lumber-yards).

Wood practically identical with duklítan. White nato seems to be the most abundant and widely distributed of the larger species of the genus.

Wood apparently identical with it is found occasionally among lots of miscellaneous lumber, but this may also be from other species of the same genus.

EBENACEAE.

[Ebony or Camagon family.]

A family of two genera of small to medium sized trees, one genus, *Maba*, producing ebony and the other genus, *Diospyros*, producing the woods broadly classed together as the camagons, which, when black, also produce wood that is ebony. To the latter genus belong also the American and Asiatic persimmons, the angoche wood of Africa (a nearly jet black ebony), and most of the black or streaked ebonies of the entire Indo-Malayan region.

Though varying widely in the relative proportion and the coloring of sapwood and heartwood, all the woods of the family are practically indistinguishable as regards their structure. (*See* Pl. IX, fig. 70.)

Wood hard to very hard; heavy to very heavy, specific gravity ranging up to about 1.050; sapwood tough and flexible, heartwood brittle; sapwood small to very large, up to 20 centimeters thick, whitish, yellowish, or red, generally sharply distinguished from heartwood; heartwood black with rosy, yellowish, brownish, or ashy streaks, sometimes nearly or quite black; whether or not a given species produces black heartwood depends largely on the size attained, but evidently also on other conditions, as there is a wide variation in the relative amounts of sapwood and heartwood in individuals of the same species; grain generally very straight; texture fine, smooth and (especially in the heartwood) very dense; difficult to season well, logs almost invariably checking in several directions from the heart outward, while sawn lumber must be stacked carefully and weighted to

prevent warping; once thoroughly dried, however, it becomes very stable; difficult to work, but takes a beautiful surface under sharp tools. Durability of heartwood I, of sapwood II, but even the latter practically never attacked by beetles, though not termite-proof.

Structure.—Pith rays numerous, fine, in unstained sapwood distinct, but in stained sapwood indistinct and in heartwood almost invisible; pores few, small or very small, evenly distributed either singly or in short radial rows; soft tissue forming very thin rings about pores and very numerous (6 to 10 to the millimeter of radius), crinkly, concentric lines, sometimes very distinct, sometimes rather ill defined; growth rings, if present, not differentiated in structure, but marked by ill-defined belts of lighter and darker color.

Uses.—Small trees containing little or no heartwood are used locally in the provinces for posts, beams, joists, rafters, window sills, parts of agricultural implements, etc.; also, in lumbering, small poles are used for skids on account of their hardness, toughness and smooth wearing qualities; heartwood (or sometimes sap and heart together) for scabbards, canes, hilts, tool handles, gunstocks, saw frames, etc.; a favorite for musical instruments, especially finger boards and keys of guitars; furniture, cabinetwork, inlaying; paper weights, inkstands and similar desk supplies; the sapwood, which is almost as hard as the heartwood and very much tougher, is an excellent material for T-squares and other drawing instruments, for shuttles, bobbins, spindles, golf-club heads and shafts, ax, pick, and hammer handles, etc.

Supply and prices.—One or more species found in practically every province, but scattered, and large trees rare. Whole logs sell in Manila at from ₱35 to ₱70 per cubic meter (₱1 to ₱2 per cubic foot) select small lots of sound heartwood at from ₱300 per M. board feet upward.

Genus DIOSPYROS.

A genus of about 35 species, of which the most important ones may be roughly divided into four groups according to the character of the sapwood.

I. Sapwood pinkish or pale red: The camagon group.

D. copelandii Merr. TÁLANG-GÚBAT.

A tree up to 40 centimeters in diameter; reported from: Bat., Riz., Lag., Tay.

Local names.—Bolong-éta (Lag.); kamagóng (Riz.); sapóteng-húlo' (Bat.); TÁLANG-GÚBAT (Riz.).

Wood, as far as known, same as following.

D. discolor Willd. CAMAGON.[1]

The best known and one of the largest trees of the genus, reaching ordinarily about 60 centimeters in diameter, but one log is known which, without sapwood, measured 76 centimeters at the butt.

Local names.—Where cultivated for its fruit, almost always known as mabúlo, except in southern Luzon, where it is more commonly known as kamagóng (camagón); where cut for timber, generally by the latter name or bolong-éta, baling-agtá', etc.; in the Bisayas and Mindanao, itomán, itom-itóm, etc.; in northern Luzon any black wood of this genus or the following is known as ballatináu, batulináu, etc.

Sapwood sometimes up to 20 centimeters thick, generally retaining its

[1] The Spanish form of the Tagalog, Bikol, and Bisaya name kamagóng.

reddish or pinkish color, but sometimes staining more or less to a dull gray; heartwood streaked and mottled, sometimes nearly dead black.

D. mirandae Merr.

A tree up to 70 centimeters in diameter, reported only from Cotabato with local name bantulinái. Wood apparently same as camagon.

D. pilosanthera Blco. BOLONG-ÉTA.

A tree up to 50 centimeters in diameter; very widely distributed and better known than any other of the genus except camagon.

Local names.—Most generally known as BOLONG-ÉTA, baling-agtá, etc.; also: ánang (Cam.); ata-áta (Neg., Tinago); baganíto' (Sam.); balatináu (N. Luz.); malapuyáu (Tay.); malatálang (Pamp.); marabikál (Cam.); very often confused with camagon.

Wood identical with camagon, but bolong-éta has, as a general rule, a much larger sapwood and smaller heart than camagon.

D. plicata Merr. TÁMIL.

A tree up to 40 centimeters in diameter; reported from Tay., Cam., Cota., Zambo., Bas.

Local names.—Malagaítmán (Tay.); palo negro, TÁMIL (Cota.); taming-táming-babáe (Zambo.). Wood apparently identical with camagon.

D. whitfordii Merr.

A tree up to 35 centimeters in diameter, reported only from Surigao and Zamboanga.

Local names.—Mahúyan (Sur.); kamagóng (Zambo.). Wood identical with camagon.

II. Sapwood almost white, turning yellowish in seasoning, but often staining, either evenly or in streaks and mottlings, to light gray; of slightly coarser texture than average camagon; heartwood of all species jet black, but small and often defective: The ata-ata group.

D. ahernii Merr. ÁNANG.

A tree up to 30 centimeters in diameter; reported from: N. Luz., to Cam., Sam., Ley., Neg., Bil., Bas.

Local names.—ÁNANG (Lag., Cam.); ata-áta (Neg.); kabág (Isa.); kanalum (Neg.); pugáui-itím (Lag.); tálang-gúbat (Riz.).

D. alvarezii Merr.

A tree up to 40 centimeters in diameter; reported only from Camarines, local name bantulináu.

D. curranii Merr. MALAGAITMÓN.

A tree up to 50 centimeters in diameter; reported from: Riz. to Sor.; Mar., Neg., Dav., Lan., Mis.

Local names.—Alináu (Cam.); ánang (Tay.); ataáta (Neg.); baganíto' (Cam., Sor.); bolong-éta (Riz., Tay.); MALAGAITMÓN (or -mán), (Tay., Cam., Mar.); panagitmón (Cam.).

D. foveo-reticulata Merr. KULITÓM.

A tree up to 45 centimeters in diameter; reported from: Cam., Cota., Zambo., Bas.

Local names.—Kamagóng (Bas.); KULITÓM (Zambo.); palo negro (Cota.).

D. mindanaensis Merr. ATA-ÁTA.

A tree up to 50 centimeters in diameter; one of the largest and most widely distributed and probably the best known of this group, so that the wood of the other species, when its origin is unknown, is generally called ata-ata.

Local names.—Ánang (Tay.); ATA-ÁTA (Neg., Sam.); bolong-éta (Tay., Sib., Bas.); itom-itóm (Lan.); malagaitmán (Tay.); támil-lalaki (Lan.).

III. Sapwood almost white or with faint reddish tinge, but almost invariably changing shortly after felling to an even bluish gray, as if stained with dilute ink, whence the Pampanga name malatinta; heartwood as in the previous group: The kanomoi group.

D. buxifolia Hiern

A tree up to 25 centimeters in diameter; reported only from Zamboanga and Palawan, with local name ébano.

D. camarinensis Merr.

A tree up to 40 centimeters in diameter; reported only from Camarines, local name kanúmai.

D. maritima Bl. MALATÍNTA.

A tree up to 30 centimeters in diameter; reported from: Pang. to Alb.; Pol., Min., Tab., Boh., Tic., Mas., Ley., Cap., Guim., Neg., Sur., Zambo., Bas., Cul., Pal.; always with same names as following and MALATÍNTA (Pamp.).

D. multiflora Blco. (*D. canomoi* A. DC.). KANÓMOI.

A tree up to 60 centimeters in diameter; reported from: N. Luz. to Cam.; Zambo.; always with local name KANÓMOI, kanúmi, kanúmai, kalúmai, etc. This species probably furnishes part of the blue-gray wood used by musical instrument makers in Pampanga and Manila under the name malatinta.

D. nitida Merr. KATILMÁ.

A tree up to 30 centimeters in diameter; reported from: Beng., Un., Pang., Pamp., Zam., Bat., Bul., Riz., Pol., Min., Guim., Mis., Dav.

Local names.—Atilmá' (Bul.); kanálum (Zam.); karánung (Min.); KATILMÁ' (Riz.); malatínta (Pamp.); manogaróm (Guim.).

IV. Sapwood with distinct yellowish tint, becoming light yellowish brown in drying; light streaks in heartwood also yellowish brown; heartwood good commercial camagon.

D. philippinensis A. DC.

A tree up to 30 centimeters in diameter; reported from: Pang., Bat., Riz., Cam.

Local names.—Bolong-éta (Cam.); kanúmai (Bat.); oi-ói (Bat.).

D. velascoi Merr.

A tree up to 25 centimeters in diameter; reported from Cagayan.

Commercial wood specimens from Sorsogon and Siquijor are of this type, indicating that one of these species is also found further south than the above range.

Genus MABA.

M. buxifolia Pers. (Pl. IX, fig. 70.) BATULINÁU OR EBONY.

A tree up to 40 centimeters in diameter; very widely distributed, being reported from practically every island and province in the Archipelago

except Cebu, Bohol, the Romblon group, Busuanga, Palawan, and the Sulu group, but scattered and the great majority of trees small.

The Spanish name ébano is widely known; the commonest Philippine name is BATULINÁU (Cag., Pang.), with many variations as: Bantulináu (Cam., Sor., Mas., Sur., Din.); batlatináu (Pang.); bulatináu (Cag.); palatináu (Pang.); it is also often confused with the various species of *Diospyros* and names belonging to these applied to it.

Sapwood whitish, often staining to dull, light gray in seasoning; heartwood jet black; if streaky, the streaks are always whitish or grayish, never yellow, red, or brown; very hard, but brittle, very dense, and apparently heavier than all but the very blackest and densest heartwood of the camagons.

LOGANIACEAE.

[Urung family.]

A family represented by a single timber tree, well known but not important.

Genus FAGRAEA.

F. fragrans Roxb. (Pl. IX, fig. 71.) URUNG.

A tree up to 90 centimeters in diameter, but generally much smaller and with a rather short and often irregular bole; reported only from Palawan and adjacent islands, where it is said to be fairly common in some regions, and from Mindoro (a single specimen).

Local names.—Dólo or dúlu; URUNG and sometimes teca (Span. for "teak"); susulin (Min.).

Wood hard; heavy; sapwood 2 to 4 centimeters thick, pale yellow; heartwood yellow to light brown; grain straight, in tangential sections with a distinct figure formed by the bands of soft tissue, resembling the yellow *Garcinias;* texture rather coarse in appearance, but dense, taking a smooth, but not glossy surface under sharp tools; when fresh, with a distinct aromatic and somewhat acid odor reminding one of cider; seasons well, but liable to split at ends; easy to work. Durability I; not rapidly attacked even by termites and teredo.

Structure.—Pith rays numerous, fine; pores rather few, medium sized to large, scattered, the larger ones singly, the smaller in short irregular radial rows, all rather obscure, being both surrounded by and more or less filled with loose tissue; soft tissue in numerous narrow concentric lines (2 to 6 per millimeter of radius); no growth rings.

Uses.—Piling; posts; ties, sills; boat anchors; a pretty, easily worked, but strong and durable cabinet wood.

Supply.—Scarce; rarely, if ever, brought to Manila market.

Prices.—No sales recorded.

APOCYNACEAE.

[Dita family.]

A large family containing several well-known timber trees. By far the best known wood is lanete, which, for its fineness of texture, ease of working and pure creamy white color, is the prime favorite for delicate carved articles. The woods of this family are practically all whitish or yellowish, of fine texture, with numerous fine pith rays and small pores with tendency to form radial rows; several have a distinct bitter taste.

Genus ALSTONIA.

A genus of about five species, of which all but dita furnish wood practically identical in general appearance and structure.

A. macrophylla Wall. (Pl. IX, fig. 72.) BATÍNO.

A tree up to 50 centimeters in diameter; reported from: I. N., I. S., Cag., Isa., Pang., Bat., Riz., Lag., Batg., Tay., Cam., Min., Guim., Lan., Dav., Bal., Pal.

Local names.—Basikálang or basikárang (I. N., Cag., Isa.); batikalág, batikaláng (Pang.); BATÍNO (Riz., Lag., Batg., Tay., Cam., Min.); dalákan (I. S.); itang-ítang (Guim.); kalatúche (Pang.); kuyaukuyáu (Cam.); pañgalisoklóen (Pang.); pañgolaksién (Cag.).

Wood heavy; hard; pale yellowish white, sometimes with faint pinkish tinge, without distinct sapwood and heartwood; of fine, even texture and straight grain; distinct bitter taste; disagreeable odor when freshly worked; easy to work. Durability II; not attacked by beetles.

Structure.—Pith rays fine, very numerous, distinct; pores small or very small, very numerous, mostly in long radial rows; soft tissue scattered, inconspicuous; growth rings inconspicuous, sometimes marked by a narrow line of dense wood.

Uses.—Posts above stumps; beams, joists, rafters; flooring; furniture and cabinetwork; household implements; ties.

Supply.—Limited.

Prices.—Formerly high priced (up to ₱180 per M.), but no sales recorded recently; comes to market occasionally in mixed lots and has been cut for ties, which are graded as second class and bring from ₱1.25 to ₱1.50 each.

The following three species appear to have wood practically identical with batino:

A. oblongifolia Merr.

A small tree, reported only from Bataan.

A. parvifolia Merr.

A small tree, reported only from Bataan.

A. paucinervia Merr.

A tree up to 30 centimeters in diameter; reported only from Camarines, with local name batíno.

The following single species has wood of a quite different character:

A. scholaris R. Br. (Pl. X, fig. 73.) DITÁ.

A tall straight tree up to 100 centimeters or more in diameter; reported from: I. N., Cag., Isa., Abra, Bont., Pang., Un., Bat., Riz., Lag., Batg., Tay., Cam., Alb., Min., Sam., Ley., Neg., Ilo., Sib., Bal., Pal.

Local names.—Alipáuen, dalipáuen, or lipáuen (I. N., Cag., Abra, Un.); andaráian (Cag.); bitá (Bat., Ilo.); diritá (Bat., Cam.); DITÁ or ditáa (Pang., Bat., Riz., Lag., Batg., Tay., Cam., Alb., Sam., Neg., Ley.); layá (I. N.); oplái (Cag.); pasnít, polái (Pang.); tanítan, tañgítang (Bis.).

Wood soft and light, specific gravity about 0.450 (Gamble) to 0.531 (Puigdulles); whitish, bluing easily if not quickly seasoned, no distinct heartwood and sapwood; bitter taste; faint sweetish odor; texture fairly fine, variable; grain even, sometimes twisted or curly; very easy to work, but cross section can only be smoothed with an exceedingly sharp tool. Durability IV, but not attacked by insects.

Structure.—Pith rays small, not as numerous as in batino; pores of medium size, few, scattered, some in radial strings of 3 to 6: soft tissue forming very regular concentric lines, more conspicuous than pith rays; growth rings sometimes hardly noticeable, sometimes conspicuous, and sometimes with denser wood at inside and less dense wood at outside of ring.

Uses.—Light construction; light household implements, such as wash-bowls, etc; wooden-shoe soles; ceilings; molds or forms for basket weaving; match wood; musical instruments (Puigdulles); said to have been used for drawing boards.

Supply and prices.—Limited; never cut for Manila market and no sales recorded.

Genus PARALSTONIA.

P. clusiacea Baill. MALABATÍNO.

A tree up to 45 centimeters or more in diameter; reported from: Bat., Riz., Batg., Tay., Min., Mas., Sam., Neg.

Local names.—Batikulíng (Riz.); bayag-usá (Min.); ditá (Bat.); MALABATÍNO (Tay.); maladitá (Batg., Tay.); tañgítang (Neg.).

Wood in all respects similar to batino and would pass as such in the market.

P. platyphylla Merr.

A tree up to 75 centimeters in diameter; reported only from Basilan; the wood is unknown, but commercial batino from Basilan is perhaps of this species.

Genus WRIGHTIA.

A genus of three or four species of trees up to 60 centimeters or more in diameter, but with a short and irregular bole. The wood of all species seems to be practically identical in general appearance and in structure.

The local names are applied to all species indifferently and are given here for the whole genus:

Bulála na tolón (Isa.); baníti' (Cam.); ñgoioñgói (N. V.); LANÉTE,' laníti' or lanutí' (I. N., I. S., Cag., N. E., Abra, Bul., Zam., Bat., Riz., Man., Lag., Tay., Cam., Alb., Min., Mas., Sam., Ley., Neg., Cap., Ilo., Guim., Zambo.); tañghás (Lag., Tay., Min.).

Wood light; soft to moderately hard; creamy white, sometimes with distinct rosy tinge, or irregular rosy streaks, without distinct sap and heartwood; of very fine texture and generally straight, but sometimes crossed or wavy grain; slight unpleasant odor when fresh; very easy to work and finish. Probably not very durable when exposed, but not attacked by insects.

Structure.—Pith rays numerous, extremely fine, not conspicuous even under the lens; pores minute, very numerous, rather regularly arranged in radial lines; soft tissue inconspicuous; growth rings not conspicuous, marked by a narrow, indistinct line of denser wood. (Plate X, fig. 74.)

Uses.—Sculpture and carving, picture frames, carved jewel boxes, household implements; pyrography panels; musical instruments (necks, heads, trimmings); altars; next to baticulin, the most sought-for wood for sacred images.

Supply and prices.—Very limited; very rarely comes into market as saw timber; clear and fairly wide boards (say up to 30 centimeters wide) bring ₱300 or more per M.; sculptors, musical instrument makers, etc.,

buy logs or short bolts at prices ranging from about ₱20 up to ₱40 or ₱50 per cubic meter; small quantities are smuggled into Manila in loads of cordwood, to avoid the expense and trouble of paying first-group forest charges (₱2.50 per cubic meter).

The following are the best-known species of *Wrightia*:

W. calycina A. DC. SOUTHERN LANÉTE.

A tree 30 centimeters or more in diameter; reported from: Lag., Tay., Cam., Min., Mas., Sam., Ley., Neg., Cap., Ilo., Guim., Bil., Lan., Zambo.

W. laniti Merr. (Plate X, fig. 74.) LANÉTE.

A tree 60 centimeters or more in diameter; reported from: I. N., I. S., Cag., Isa., Lep., Bont., N. V., Pang., Zam., Bat., Riz., Lag., Min., Neg., Cul., Pal.

A great number of large shrubs and small trees, belonging to the genera *Alyxia, Kickxia, Kopsia, Lepiniopsis, Rauwolfia, Tabernaemontana,* and *Voacanga* furnish woods similar to lanete, which are used locally for small carved articles, kitchen utensils, scabbards, etc., and some of which are occasionally cut and sold as lanete, from which they are difficult to distinguish and for which, if seasoned without staining, they are perfectly good substitutes.

BORRAGINACEAE.

[Anonang family.]

A family containing in the Philippines two timber trees of no great importance; one of which, however, is very widely distributed and well known, while the other furnishes a very pretty wood.

Genus CORDIA.

C. myxa L. (*C. blancoi* Vid.). ANÓNANG.

A small to medium sized tree, up to 60 centimeters in diameter, generally with a short and irregular trunk; reported from: I. S., Beng., Bont., N. V., Pang., Pamp., Bat., Riz., Man., Lag., Batg., Tay., Cam., Alb., Sor., Min., Mas., Bur., Ley., Cebu, Guim., Sur., Mis., Dav., Lan., Cota., Zambo., Bas., Bal., Pal.

Local names.—ANÓNANG (I. S., Beng., Pang., Pamp., Bat., Riz., Man., Lag., Batg., Tay., Cam., Alb., Sor., Min.); bibíli (Bis.); gúma (Bal.); salóyong (Tag.); sinalígan (I. S.).

Wood soft; light; grayish brown, darkening slightly in drying; when fresh cut, clear yellow, but often changing after a few minutes' exposure to greenish or bluish gray; large trees may have a distinct heartwood as in balu, but no specimens are known; grain straight or slightly crossed; texture fairly fine, but not glossy; very easy to work. Durability probably poor, but not attacked by pinhole beetles.

Structure.—Pith rays moderately broad, not numerous, straight, conspicuous; pores large, scattered, often compressed between rays, occasionally with one or two partitions; soft tissue forming very numerous, conspicuous concentric bands as broad or broader than the intervening bands of denser tissue; growth rings, if present, very ill defined.

Uses.—Posts, light construction. The bast is used locally for rope.

Supply.—Limited.

Prices.—Rarely marketed as lumber, except among miscellaneous lots selling at about ₱40 per M.

C. subcordata Lam. BÁLU.

A tree up to 55 centimeters in diameter; reported from: Cag., Un., Riz., Batg., Tay., Pol., Cam., Min., Bur., Dav., Cota., Zambo., Bas., Sulu, Taw., Pal.

Local names.—Agotót (Bur.); agutúb (Cebu); agutúd (Sulu); BÁLU (Sulu, Taw.); balungkauái (Pal.); banágau, banágo, banálo (Tay.); bibíli (Bis.); kamanak-manák (Cota.); sin͠gángdágat, sin͠gáu-dágat (Cam.).

Wood moderately heavy; hard, sapwood small (1 to 3 centimeters), pale grayish brown; heartwood very sharply marked off, light to dark brown with rather irregular, narrow, darker, or nearly black, belts; pungent aromatic odor similar to that of calantas (*Toona* spp.) when freshly worked; texture fairly fine; grain sometimes rather wavy; not difficult to work and takes a good finish.

Structure.—Pith rays fine to moderately broad, indistinct; pores small to medium, scattered, often partitioned, some with whitish and some with dark glistening deposits and with a tendency to form tangential rows; growth rings very indistinct but sometimes marked by a fairly broad band of very porous tissue.

Uses.—Musical instruments, scabbards, small cabinetwork.

Supply.—Widely distributed from southern Luzon to Sulu, but scarce.

Prices.—Not brought to market, except rarely in short logs for musical instrument makers.

VERBENACEAE.

[Molave family.]

A family containing a number of timber trees, but in the Philippines only one important wood, molave. Teak, which is only found planted in certain regions, is of very little importance on account of its scarcity.

Woods mostly yellow or brownish; pith rays fine to moderately broad, pores small or medium size, scattered; soft tissue inconspicuous. Api-api (*Avicennia officinalis*) has a purplish heartwood and an entirely different structure.

Genus AVICENNIA.

Two species, both small to medium sized trees of the mangrove swamps.

A. alba Bl.

A tree up to 40 centimeters in diameter; reported from: Sur., Mis., Lan., Cota.

Local names.—Kachúchis (Sur.); piápi (Mis.); pundúng (Cota.). Wood identical with following.

A. officinalis L. (Pl. X, fig. 75.) API-ÁPI.

A tree up to 80 centimeters in diameter; reported from the following regions (but probably found in all tidal swamps); Cag., Pang., Bul., Zam., Bat., Tay., Pol., Cam., Min., Mas., Mar., Ley., Ilo., Cebu, Neg., Sur., Mis., Dav., Cota., Zambo., Bus., Pal., Sulu Arch.

Local names.—API-ÁPI (Bat., Min., Dav., Cota., Zambo., Pal.); bun͠gálon (Pang., Zam., Tay., Cam., Min., Mar., Ilo., Neg.); kalapíni (Pang., Zam., Bat.); kulási (Cota.); lin͠góg (Cag.); miápi (Ley.); piápi (Ilo.); piksík (Min.); pipisík or pipisíg (Tay., Cam., Min.).

Word hard, brittle, but difficult to split; heavy; sapwood 4 to 6 centimeters thick, whitish, turning in drying to gray or light brown, in large trees sharply marked off from heartwood; heartwood purplish gray; grain

very conspicuous from alternate bands of hard and soft tissue, somewhat crossed, often irregularly wavy; texture of hard tissue extremely fine and dense, of soft tissue somewhat coarser; seasons well, but sapwood liable to stain badly if not seasoned quickly; not difficult to work. Durability said to be poor, but rarely attacked by beetles.

Structure.—Pith rays fine; pores very variable in size, in short radial rows in bands of hard tissue; soft tissue in numerous, conspicuous, narrow concentric lines, often branching and confluent or even connected by cross channels at right angles to two or more parallel lines.

Uses.—Used locally for rice mortars; a favorite in some regions for smoking fish; a wood that for its peculiar color and attractive grain should find a good place in small cabinetwork; recommended for trial in creosoted paving blocks.

Supply and prices.—Rarely if ever cut for timber; sometimes cut with miscellaneous swamp firewoods; much more rarely by larger operators with cheap grades of miscellaneous lumber.

Genus TECTONA.

T. grandis L. f. (Pl. X, fig. 76.) TEAK.

Teak is not native to the Philippines, but was sparingly introduced so long ago that trees up to 80 centimeters in diameter have been found. It is reported from one or two localities in Luzon, from Cotabato, Zamboanga, Basilan, and the Sulu group, and the writer was shown in a Manila yard boards from a single log said, on good authority, to be from Palawan. The teak used by the U. S. Navy Yard, the Insular Government bureaus, and private firms in Manila is all imported.

Genus VITEX.

A genus containing about nine species of medium sized to large trees, of which only two are very widely distributed and well known, molave and sasalit, the former being, excepting narra, the most highly esteemed and most variously used wood of the Islands.

Three other species, *V. celebica*, *V. longifolia*, and *V. pubescens*, have woods closely resembling molave, and the last named of the three probably contributes a small percentage of commercial molave. Some of the remaining species have softer, lighter, and much less durable wood commonly known as mulâwin-âsu ("dog-molave"), a name properly belonging to a small tree, *Premna nauseosa* Blco., of the same family, having a wood similar to them. However, this name as well as mulâwin-babáe ("female molave") and other names implying lesser strength and durability are also given to the true molaves when these, owing to rapid growth in specially favorable situations, form a softer, lighter wood than usual.

Though there are wide variations in hardness and durability among the different species, the structure of all is very similar, the pith rays being fine and numerous, pores small, scattered, soft tissue inconspicuous, and growth rings, if present, generally irregular and often very ill defined.

V. aherniana Merr. (Pl. X, fig. 77.) SASÁLIT.

A tree up to 75 centimeters in diameter, but generally much smaller, with a rather short and often crooked and fluted bole; reported from: Cag., Pang., Zam., Lag., Tay., Cam., Alb., Lub., Sam., Ley., Ilo., Sib., Neg., Zambo.

Local names.—Amamáhit or amamáhi' (Sib.); dalipápa, galipápa

(Cag.); dañgúla, duñgúla? (Neg., Ilo.); didigkalín (N. Cam.); igáng (N. Tay.); kulipápa (Alb., Sam., Ley.); malaigáng (Lub.); SASÁLIT (Zam.).

Wood very hard, strong and stiff, but easy to split; very heavy, specific gravity 0.742 to 0.995 (Gardner); sapwood 1 to 3 centimeters thick, yellowish, rather sharply distinguished from heartwood; heartwood light amber to dark yellowish brown; grain generally very straight; texture extremely dense and fine, taking a glossy surface under sharp tools; seasons well, except for splitting at ends; in no way difficult to work except for its hardness. Durability I; even sapwood rarely if ever attacked by insects and heartwood hardly by teredo; there is on record a pile in a wharf in Legaspi harbor, Albay, said to be 34 years old.

Structure.—Pith rays numerous, fine, distinct; pores few, small or very small, scattered; soft tissue scarcely visible; growth rings, if present, very ill defined.

Uses.—Piles; posts; bridges and wharfs; ties; foundation sills; tool handles and other wooden tool parts; practically all uses to which molave is put; superior to molave for all uses requiring transverse strength.

Supply and prices.—Very limited; comes into Manila market occasionally in logs and sells at about the same prices as high grade molave.

V. celebica Koord. KALIPÁPA-MÁDAM.

A tree up to 35 centimeters or more in diameter; reported only from Agusan and Cotabato, with above name and kalipápa-ásu. The wood seems to be a fairly hard grade of molave.

V. longifolia Merr. LONGLEAF MOLÁVE.

A tree 30 centimeters or more in diameter; reported only from Agusan; local names; atikóko, manamu, sikúkok.

Wood soft, light, resembling that of *V. philippinensis*.

V. parviflora Juss. (Pl. X, fig. 78.) MOLÁVE.[1]

A tree up to 200 centimeters or more in diameter, with generally a short, crooked and fluted bole; reported from: I. N., Cag., I. S., Abra, Bont., Beng., N. V., N. E., Pang., Tar., Un., Zam., Bat., Pamp., Bul., Riz., Lag., Batg., Tay., Cam., Alb., Min., Mas., Mar., Tic., Cat., Sam., Ley., Guim., Cebu, Siq., Neg., Bohol, Sur., Agus., Mis., Dav., Cota., Zambo., Bas., Cuyo, Pal., Sulu Arch.

Local names.—Adgáuon (Sam., Ley.); ambuláuan (Sulu Arch.); amuáuan (N. V.); amugáuan (Cag., N. E.); amuráuon (Mas.); amuyáuon (Sur.); buláuen (Pang., Pamp.); hamuráuon (Cam., Alb., Sam., Ley.); hamuyáuon (Sur.); himuláuon (Sulu Arch.); kalipápa, kulipápa, kulimpápa (Mis., Cota., Zambo., Bas.); muláuin (N. E., Pang., Zam., Tar., Bat., Bul., Riz., Lag., Tay., N. Cam., Min.); muráuin (Mas., Tic.); muráuon (Guim.); salingkápa (Guim.); sagát (I. N., Cag. I. S., Un., Pang.); tugás (Sam., Ley., Cebu, Neg., Sur., Agus.); taggá' (Cag.).

Wood hard, stiff, brittle; heavy, specific gravity 0.778 (Foxworthy), 0.690 to 0.880 (Gardner); sapwood small, slightly lighter and scarcely distinct from heartwood; heartwood pale straw color to light brown, sometimes with greenish tints; lime water or other alkalis stain it bright greenish yellow; chips give yellow color to water; grain sometimes straight or very slightly crossed, sometimes very wavy and curly; texture dense, fine, very smooth under sharp tools; seasons with little warping, but is

[1] Not strictly a native name, being the Spanish pronunciation and spelling of the Tagalog mulâwin or moláuin, now more widely known than any other native name.

very liable to develop large, deep, irregular checks, so much so that in tests of 4 by 4 inch by 6 foot beams the average modulus of rupture of seasoned beams was about 20 per cent lower than that of unseasoned ones; easy to work, perhaps the easiest of all Philippine woods of equal hardness and density. Durability I; destroyed only very slowly by teredo, and probably rarely attacked by termites, except where previously softened by long exposure under very severe conditions.

Structure.—Very similar to sasalit, but general appearance of cross section less dense and glossy, and growth rings more distinct, often marked by a very narrow line of looser tissue.

Uses.—Piles; posts; ties; paving blocks; ship, wharf, and bridge building; foundation sills; window sills; doors; windows; flooring; stairs (treads, risers, balusters, handrails); siding; sheathing; all kinds of interior finish; all kinds of structural parts except long beams; furniture and cabinetwork; sculpture and carving; wooden type and woodcut engraving; tool handles, plane stocks and other wooden tool parts; pestles, mortars, and other household implements; framing of hemp presses, sugar mills, etc.; cogwheels and inserted cogs; agricultural implements; yokes.

Supply.—Limited; there is always a small supply in Manila yards, generally of small to medium sized logs to be sawn to order; lumber is less often found, nor have the mills in the provinces any considerable stock on hand. Orders amounting to a number of thousands of board feet generally require several months to be filled.

Prices.—One hundred and eighty pesos to ₱250 per M.

A part of the commercial molave from Mindanao is from an unknown species very probably distinct from any of those here described.

V. pentaphylla Merr. KALIPAPÁ-ÁSU.

A tree up to 40 centimeters or more in diameter; reported from: Cam. (?), Agus., Dav., Zambo., Pal.

Local names.—Amuláuon (Zambo.); boñgóg, boñgóog, buñgúg (Agus.); KALIPÁPA-ÁSU (Zambo.).

Wood with somewhat the appearance of molave, but much lighter and softer, more liable to stain in drying, and much less durable under severe conditions.

Uses.—Used locally for interior structural timber, flooring, etc.

Supply and prices.—Limited; does not come into markets.

V. philippinensis Merr. TIKÓKO.

A tree up to 30 centimeters or more in diameter; reported from: Sam., Bil., Ley., Dav.; only local name TIKÓKO (Ley.) Wood apparently the poorest of the genus.

V. pubescens Vahl HAIRYLEAF MOLÁVE.

A tree up to 35 centimeters or more in diameter; reported from: Min., Guim., Bal., Cul., Pal., Sulu Arch.

Local names.—Same as molave in the same regions. Wood practically identical with molave and put to the same uses. It is probable that a small part of the molave of commerce is of this species.

V. turczaninowii Merr. LIÑGO-LÍÑGO.

A tree up to 60 centimeters in diameter; reported from: Cag., I. S., Beng., N. E. Zam., Bat., Pamp., Riz., Lag., Tay., Cam., Sor., Min., Tic., Ley., Neg., Sur., Lan., Zambo.

Local names.—Boñgógon (Ley.); hamuráuon-ásu (Alb.); kalimantáu (Tay.); kamálan (Riz.); limo-limó (I. S.); LIÑGO-LÍÑGO (Cag., I. S., Beng. Zam.); malamuláuin (Riz.); malausá (Bat.); muláuin-ásu (Lag., Min.); tugás (Ley., Sur.).

Wood of general appearance of molave, but often lighter and softer; seasons well and is very easy to work. Durability III; not attacked by beetles.

Structure.—Pores much more numerous and somewhat larger than in molave and growth rings slightly more conspicuous.

Uses.—Used locally for all sorts of ordinary construction, agricultural, and household implements, etc.

Supply and prices.—Scarce; sometimes cut and brought to market for molave, but brings much lower prices than genuine molave.

BIGNONIACEAE.

[Banai-banai family.]

A family containing three genera of small to medium sized trees, of no importance in the lumber trade. The woods are all rather light and soft and of light color, but differ considerably in structure.

Genus DOLICHANDRONE.

D. spathacea K. Sch. TUWÍ.

A tree up to 40 centimeters in diameter, with a short and crooked bole; reported from: Bul., Zam., Bat., Riz., Cav., Batg., Tay., Cam., Min., Neg., Sur., Agus., Mis., Lan., Cota., Bas., Pal.; and probably more widely distributed than botanical collections indicate.

Local names.—Tañghás (Min.); tewí (Agus.); tiwí (Cam.); TUWÍ (Zam., Bat., Bul., Riz., Man., Cav., Batg., Cam., Min.).

Wood light; soft; pale yellowish or brownish white, no distinct sap and heartwood; texture rather fine, with a conspicuous figure formed by the porous concentric lines of soft tissue; very easy to work. Durability when exposed probably poor, but is not attacked by beetles and wears well in shoe soles.

Structure.—Pith rays extremely fine, barely visible even under the lens; pores small, the great majority very regularly arranged within the conspicuous concentric lines of soft tissue; concentric lines numerous, somewhat irregular, frequently branching or coalescing; growth rings, if present, irregular and ill defined.

Uses.—Wooden-shoe soles, handles of kitchen and other household implements, and of cheap bolos.

Supply.—Common along beaches and tidal rivers, but not abundant.

Prices.—Makers of wooden shoes buy bolts up to 20 to 40 centimeters in diameter at prices not exceeding ₱8 to ₱10 per cubic meter.

Genus OROXYLUM.

O. indicum Vent. PINKAPINKÁHAN.

A small to medium sized tree up to 60 centimeters in diameter; reported from: I. S., Isa., Zam., Bat., Lag., Cam., Guim., Tab., Agus., Lan., Bas., Pal.; probably more widely distributed than botanical collections indicate.

Local names.—Abang-ábang (Bis.); bálai-uák (Zambo.); balílang-uák (Tag.); baráñgau (I. S.); kampílan or kamkampílan (I. S., Isa.); maidbaíd (Cam.); pinkapínka, or PINKAPINKÁHAN. (Tag.).

Wood light; soft; pale yellowish white, without distinct sap and heartwood; texture fairly fine, grain somewhat wavy; easy to work. Durability, when exposed, IV, but not attacked by beetles.

Structure.—Pith rays fine, distinct; pores of medium size, evenly scattered, but with a tendency to arrange themselves in wavy diagonal lines across the rings; soft tissue forming small irregular patches about the pores and sometimes connecting them; growth rings sometimes indistinct, sometimes marked by a distinct belt of dense wood followed by a continuous row of pores.

Uses.—Matches and match boxes; otherwise used only locally for minor uses.

Supply and prices.—Never cut for market except for match wood, for which it brings about ₱9 per cubic meter.

Genus RADERMACHERA.

A genus of about 12 species of small to medium sized trees with a maximum recorded diameter of 80 centimeters. The wood of all species, so far as known, seems to be practically identical and the local names in various regions seem to be given to all indifferently.

Local names.—Angsóhan, badláu (Bis.); BANAI-BÁNAI (Zam., Bat., Lag., Sam.); himbaba-ó (Min.); katúrai (Zam.); lanúk (Cag.); pinggapinggáhan (Lag.); valaiváian (Bats.).

Wood light; soft; pale yellowish or pinkish white turning to a very light brown in drying, without distinct sapwood and heartwood; of rather fine texture and even straight grain; faint pleasant odor; very easy to work. Durability, when exposed, probably poor, but not attacked by beetles.

Structure.—Pith rays numerous, fine, distinct; pores small, numerous, very evenly scattered; soft tissue inconspicuous, forming very thin rings about pores and very scattered, irregular, short, transverse lines between rays; growth rings inconspicuous, bounded by a narrow band of denser wood.

Uses.—Said to be used as a substitute for baticulin in sculpture and carving; used locally for rice mortars and other household implements; a very pretty cabinet wood for all sorts of light work.

Supply and prices.—Not known in Manila market; occurs occasionally in cheap miscellaneous lots.

The following are the largest species of *Radermachera:*

R. acuminata Merr.

A tree up to 60 centimeters in diameter; reported from: Pamp., Mas., Cebu, Camiguin, Sur., Agus., Bas.

R. elmeri Merr.

A tree up to 45 centimeters in diameter; reported from Cag., Bont., Beng., Pal.

R. fenicis Merr.

A tree up to 60 centimeters in diameter; reported from: Bab., Bats., Min.

R. pinnata Seem. BANAI-BÁNAI.

A tree up to 80 centimeters in diameter; reported from: Bats., Cag., I. S., Bont., N. V., Pang., Zam., Bat., Riz., Lag., Cam., Min., Sam., Neg., Agus., Mis., Bil., Camiguin, Lan.

RUBIACEAE.

[Bangkal family.]

A very numerous family, but containing in the Philippines only two genera of trees large enough and sufficiently abundant to be of any importance. The majority of the woods of this family are whitish or yellow to red and of very smooth texture; they have numerous fine pith rays and small pores, soft tissue inconspicuous, and ill-defined or no growth rings. The coffee tree, which belongs to this family, has a very smooth, almost white wood.

Genus NAUCLEA.

A genus of about six species, of which only two are known to be large and widely distributed. The wood of all species is practically identical and in the Manila market is known only as bangkal. The local names are applied almost indifferently, depending more on the local dialect than on specific differences between the trees.

Local names.—BANGKÁL (Pamp., Zam., Bat., Riz., Mas., Lag., Cav., Tay., Cam., Alb., Sor., Min., Ley., Ilo., Neg., Sur., Cota., Zambo., Pal.); bulála (Bab., Cag., I. N., I. S., Abra, Beng., Pang., Tic.); bulubangkál, bulubitóon (Neg.); kabák (Sam., Agus.); malbóg (Sam.); MAMBÓG (Cam., Alb., Sor.).

Wood soft; light to moderately heavy, specific gravity 0.521 (Vidal), about 0.550 (Foxworthy); sapwood 2 to 8 centimeters thick, pale yellow, sometimes merging gradually into heartwood, but more often quite sharply marked off; heartwood bright canary yellow to orange, sometimes with irregular greenish or brownish streaks; grain sometimes quite straight, sometimes slightly crossed; texture fairly fine; very noticeable greasy or waxy feeling; seasons well; very easy to work. Durability III, but rarely attacked by beetles.

Uses.—House posts, framing, siding, ceiling, etc.; carved ornamental work in churches; bearings of cart axles (old style carts with wheels fixed on axle); boats; furniture, cabinetwork, sculpture.

Supply.—Limited; very rarely brought to Manila market, though used locally wherever found.

Prices.—Now rarely seen in market except occasionally mixed with cheap miscellaneous lumber, but has brought as high as ₱90 per M.

The following are the largest and most widely distributed species of *Nauclea:*

N. junghuhnii Merr. (*Sarcocephalus junghuhnii* Miq.). MAMBÓG.

A tree 50 centimeters or more in diameter; reported from: Isa., Cam., Sor., Mas., Sam., Ley., Neg., Mis., Lan., Zambo.

N. orientalis L. (*Sarcocephalus cordatus* Miq.). (Pl. X, fig. 79.) BANGKÁL.

A tree 80 centimeters or more in diameter; reported from: Bab., I. N., Abra., Bont., Beng., Pang., Zam., Bat., Riz., Man., Lag., Batg., Tay., Cam., Alb., Min., Tic., Ley., Neg., Sur., Agus., Cota., Pal.

Genus NEONAUCLEA.

A genus of over 20 species of small to medium sized trees with generally a straight but not very long bole. With the exception of slight differences of color and texture, the wood of all species is very much alike and practically all that comes to the Manila market is sold under the name of

calamansanay. The local names seem to be used almost indifferently and are here given for the whole genus without regard to species.

Local names.—Agáu (Cag.); ALINTATÁU (Lag., Cam., Sam., Ley.); ambabálud (Neg); bagariláu, bagodiláu (Lag., Min.); balung̃áu (Pang.); bálug (Neg.); bangkál (Cag., Bat., Lag., Buk., Zambo., Bas.); bugás (Neg.); bulála (Cag., Beng.); busíli (Un., Pang.); duláuen (Cag.); garunián (I. S.); himbabálud or HAMBABÁLUD (Min., Mas., Tic., Sam., Ley., Cebu, Neg.); hambabáiud (Sur.); kalamansánai or CALAMANSÁNAY (N. E., Bat., Lag., Tay., Mas.); kalíót (I. S.); kalumánog (Mas.); kudkúd (Cag.); lavuan (N. V.); LÍSAK (Tay.); lúnas (Bat.); mabálud (Guim.); magabuluán (Cota.); malabangkál (Bat.); malatibíg or malatubíg (Tay.); malatumbága (Zambo., Samal); maludbálud (Alb.); mambóg (Lag., Cam.); maragatáu (Cag.); margadiláu (Lag.); panglongbóien (I. S., N. V.); pantáuon (Cam.); tegám, tekún, tekúm, TIKÍM, etc. (Abra, Bont., Beng.); uísak or wísak (Riz., Lag.).

Wood hard; heavy, specific gravity 0.643 (Vidal), 0.626 (Puigdulles); sapwood pale yellowish or pinkish, irregular in thickness and outline, not generally clearly distinguished from heartwood; heartwood yellowish with red tinge, often irregularly marbled with darker yellowish brown or orange markings, in all species much redder when fresh than after drying, in some of an even bright rose color when fresh cut (exactly the color some palosapis takes shortly after sawing), but all degrees of pink or red tint fading out in drying to dull yellow or orange, either uniform or mottled with faint pinkish, reddish or brownish tints; grain slightly crossed in narrow belts; texture dense, fine, glossy; seasons with little checking, but liable to warp if not carefully stacked; difficult to work, being hard, dense, tough and cross-grained. Durability II; very rarely attacked by insects.

Structure.—Pith rays numerous, fine; pores small or very small, scattered; soft tissue scanty, in very thin rings about pores and in scattered dots; growth rings absent or marked by a narrow, not sharply defined belt of denser tissue.

Uses.—Posts; beams, joists, rafters and all other structural timber; bridge and wharf building; a favorite for flooring and window sills in better class of provincial houses; turned and shaped tool handles, plane stocks, etc.; furniture and cabinetwork; sometimes cut with miscellaneous lots of ties; recommended for trial, for bobbins, shuttles, etc.

Supply.—Scarce; almost always to be found in Manila market, but generally only a few logs of small size.

Prices.—One hundred and sixty pesos to ₱180 per M.

The following are the largest and best-known species of *Neonauclea:*

N. bartlingii Merr. (*Nauclea bartlingii* DC.). LÍSAK.

A tree up to 25 centimeters in diameter, according to records of botanical collections, but probably larger, reported from: Pamp., Bat., Bul., Riz., Tay., Cam., Alb., Min.

Wood of fine texture, like calamansanay, but almost entirely yellow.

N. bernardoi Merr. (*Nauclea bernardoi* Merr.). (Pl. X, fig. 80.)

A tree up to 60 centimeters in diameter; reported from: Cag., Lag., Mas., Sam., Neg.

Wood of rather more porous texture than the average, and of an even, permanent, pale reddish color. It seems rarely to come into the Manila market.

N. calycina Merr. (*Nauclea calycina* Bartl.). CALAMANSÁNAY.

A tree up to 80 centimeters in diameter; reported from: Cag., Isa., Beng., N. V., N. E., Pang., Un., Riz., Lag., Batg., Tay., Min., Mas., Tic., Neg., Cota., Zambo., Bas., Pal.

Wood the typical calamansanay of the trade; of very fine texture, brilliant rose color when fresh, fading to dull orange; probably is the chief source of the commercial calamansanay of the Manila market.

N. media Merr. (*Nauclea media* Havil.).

A tree up to 45 centimeters and probably more in diameter; reported from: Cag., Beng., Bat., Riz., Lag., Tay., Min., Lan., Zambo.

Wood very like preceding but perhaps a trifle lighter in color and coarser in texture; probably forms part of the commercial calamansanay of the Manila market.

N. philippinensis Merr. (*Nauclea philippinensis* Vid.). TIRORÓN.

A tree up to 50 centimeters in diameter; reported from: N. V., Bat., Lag., Cam., Sor., Ley.

Wood of fine texture, more distinctly brownish than other species.

N. reticulata Merr. (*Nauclea reticulata* Havil.). HAMBABÁLUD.

A tree up to 40 centimeters in diameter; reported from: I. S., Abra, Bont., Beng., N. V., N. E., Pang., Zam., Bul., Min., Ley., Ilo., Guim., Cebu, Neg., Cam., Sur., Buk., Cota., Zambo.

Wood of fairly fine texture, less red and more streaked with orange or brownish mottlings than most other species.

N. vidalii Merr. (*Nauclea vidalii* Elm.). TIKÍM.

A tree up to 40 centimeters in diameter; reported from: I. N., I. S., Abra, Bont., Beng., N. V., Pang., Pamp.

Wood fine, light reddish, very similar to typical calamansanay.

N. sp. ? ALINTATÁU.

A wood with the structure of *Neonauclea,* slightly coarser in texture than average calamansanay and of uniform bright yellow or light orange color; well known in Camarines, Samar and Leyte. There is no doubt that it belongs to this family though it may be of some other genus. It is also known as: Alintáu, pantáuon and tirorón. It is much used for house construction, being a favorite for siding and flooring, and for furniture and cabinetwork. It is practically unknown in the Manila market.

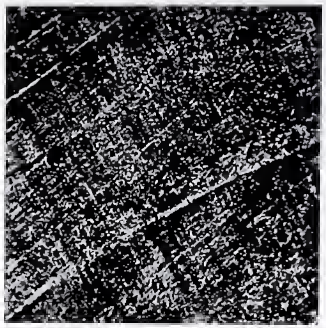

FIG. 1. Almaciga.
Agathis alba.

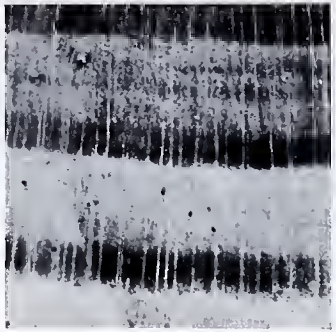

FIG. 2. Benguet Pine.
Pinus insularis.

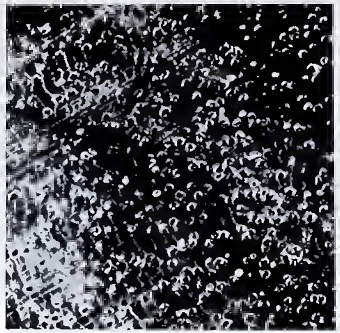

FIG. 3. Agoho.
Casuarina equisetifolia.

FIG. 4. Manaring or Oak.
Quercus soleriana.

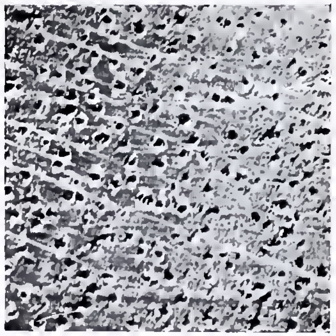

FIG. 5. Anubing.
Artocarpus cumingiana.

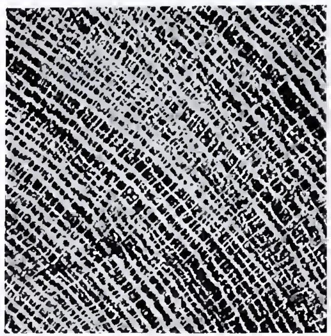

FIG. 6. Kuyuskuyus.
Taxotrophis ilicifolia.

FIG. 7. Tamayuan.
Strombosia philippinensis.

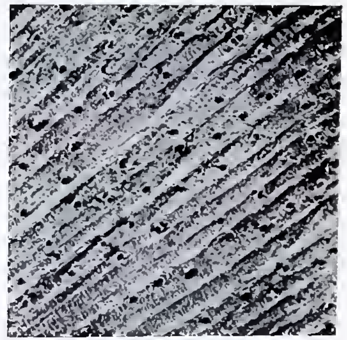

FIG. 8. Ilang-ilang.
Canangium odoratum.

[Photos by Bureau of Science.]

Plate I.

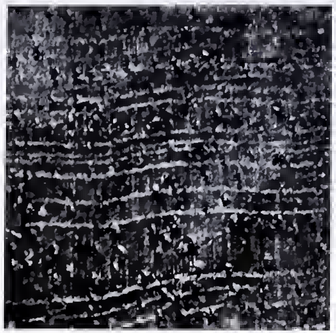

Fig. 9. Duguan.
Myristica philippensis.

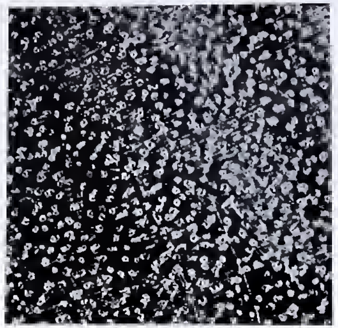

Fig. 10. Malacadios.
Beilschmiedia cairocan.

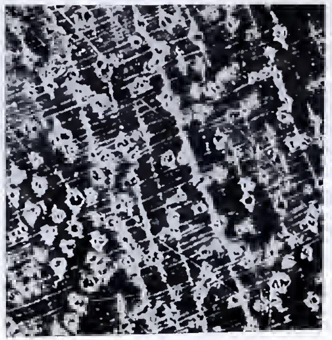

Fig. 11. Tambulian.
Eusideroxylon zwageri.

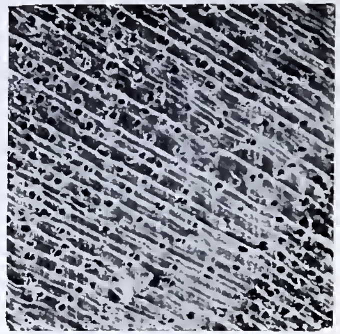

Fig. 12. Marang.
Litsea perrottetii.

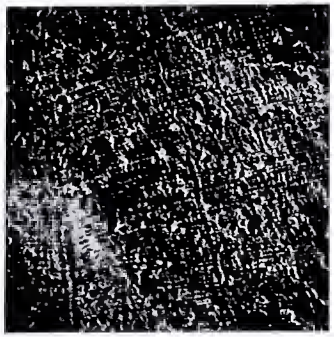

Fig. 13. Liusin.
Parinarium corymbosum.

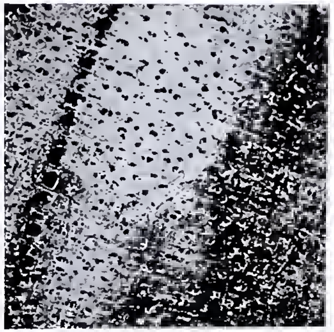

Fig. 14. Lago.
Pygeum preslii.

Fig. 15. Acle.
Albizzia acle.

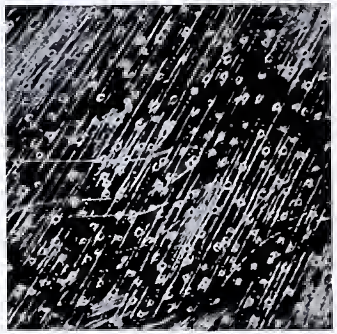

Fig. 16. Sibucao.
Caesalpinia sappan.

[Photos by Bureau of Science.]

Plate II.

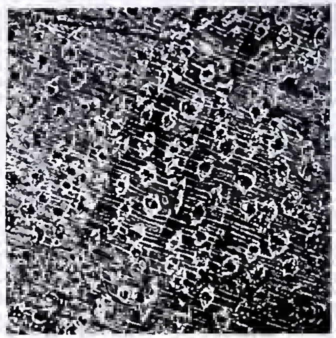

FIG. 17. Ipil.
Intsia bijuga.

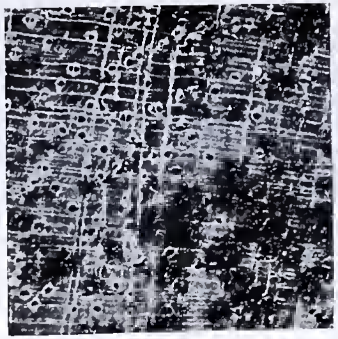

FIG. 18. Batete.
Kingiodendron alternifolium.

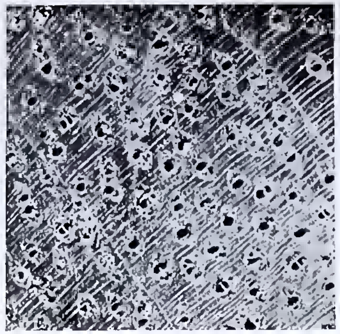

FIG. 19. Tindalo.
Pahudia rhomboidea.

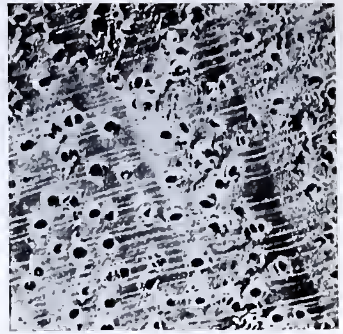

FIG. 20. Cupang.
Parkia timoriana.

FIG. 21. Narra.
Pterocarpus indicus.

FIG. 22. Supa.
Sindora supa.

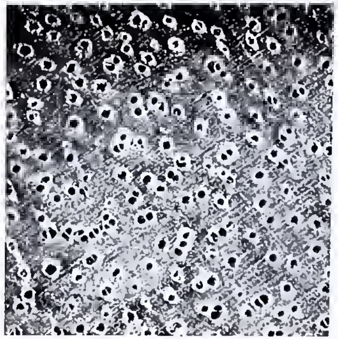

FIG. 23. Banuyo.
Wallaceodendron celebicum.

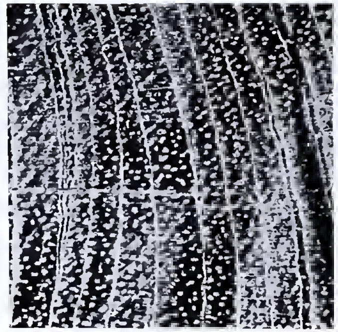

FIG. 24. Kamuning.
Murraya exotica.

[Photos by Bureau of Science.]

Plate III.

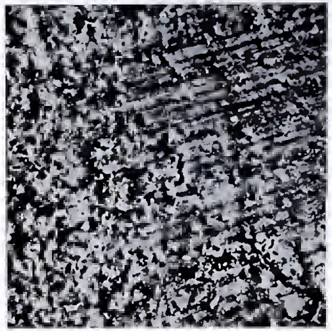

FIG. 25. Pili.
Canarium sp.

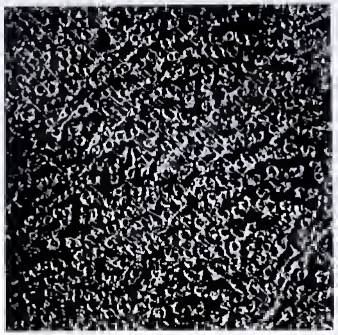

FIG. 26. Tucang-calao.
Aglaia clarkii.

FIG. 27. Kato.
Amoora aherniana.

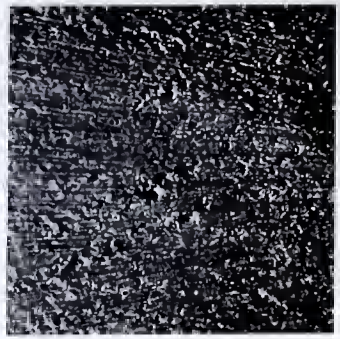

FIG. 28. Santol.
Sandoricum koetjape.

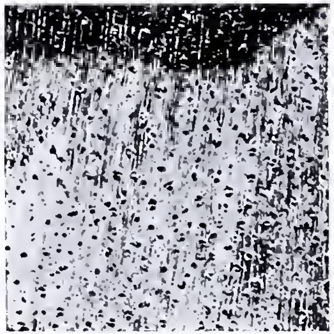

FIG. 29. Malasantol.
Sandoricum vidalii.

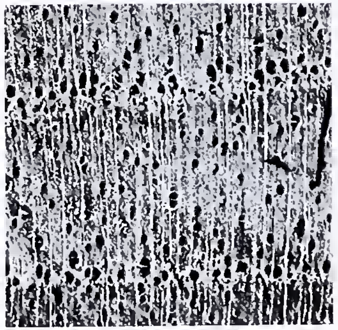

FIG. 30. Calantas.
Toona calantas.

FIG. 31. Piagau.
Xylocarpus granatum.

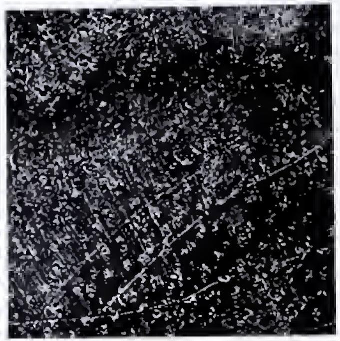

FIG. 32. Tuaí.
Bischofia javanica.

[Photos by Bureau of Science.]

Plate IV.

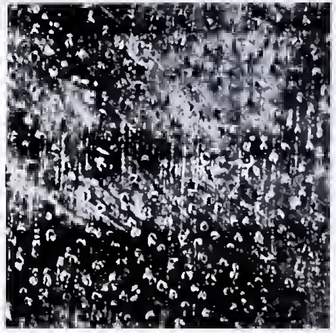

Fig. 33. Amugis.
Koordersiodendron pinnatum.

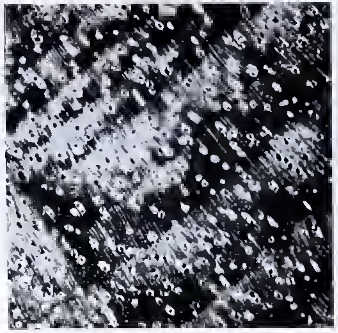

Fig. 34. Alupag.
Euphoria cinerea.

Fig. 35. Malugay.
Pometia pinnata.

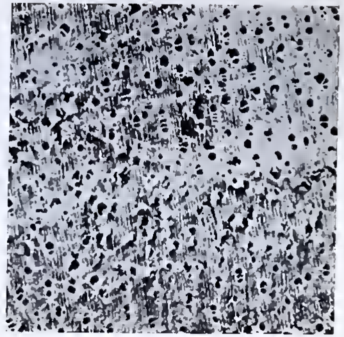

Fig. 36. Balacat.
Zizyphus zonulata.

Fig. 37. Vidal's Lanutan.
Bombycidendron vidalianum.

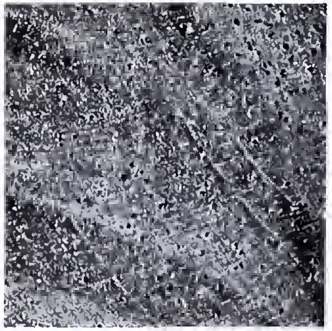

Fig. 38. Banalo.
Thespesia populnea.

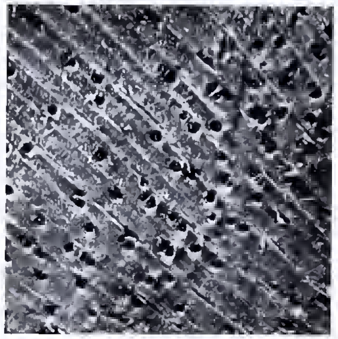

Fig. 39. Taluto.
Pterocymbium tinctorium.

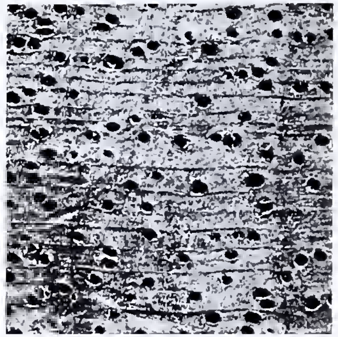

Fig. 40. Lumbayao.
Tarrietia javanica.

[Photos by Bureau of Science.]

Plate V.

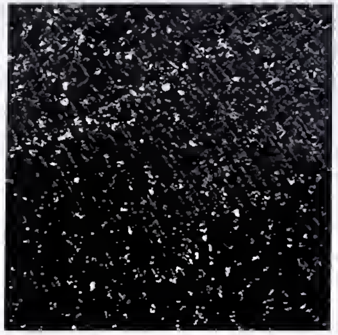

FIG. 41. Dungon.
Tarrietia sylvatica.

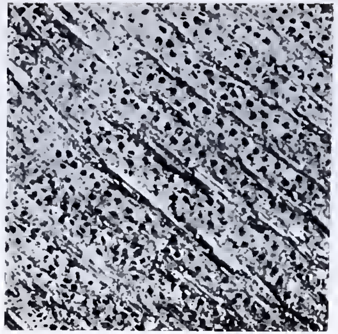

FIG. 42. Catmon.
Dillenia philippinensis.

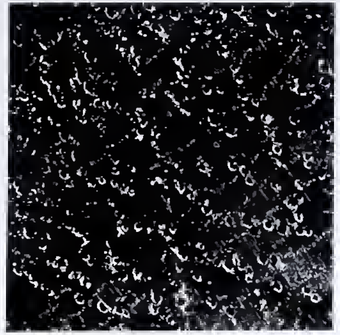

FIG. 43. Bitaog or Palomaria.
Calophyllum inophyllum.

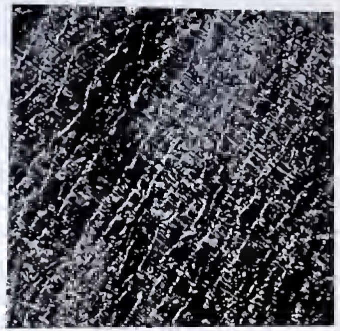

FIG. 44. Guyung-guyung.
Cratoxylon sp.

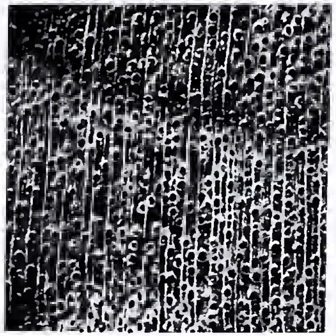

FIG. 45. Palosapis.
Anisoptera thurifera.

FIG. 46. Apitong.
Dipterocarpus grandiflorus.

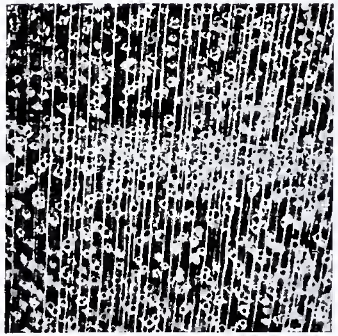

FIG. 47. Mangachapuy.
Hopea acuminata.

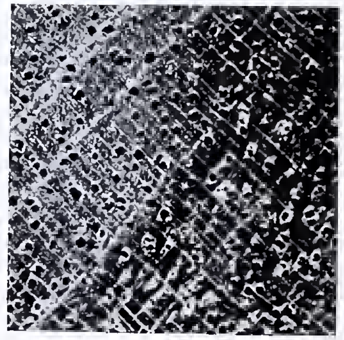

FIG. 48. White Lauan.
Pentacme contorta.

[Photos by Bureau of Science.]

Plate VI.

FIG. 49. Gisok.
Shorea balangeran.

FIG. 50. Guijo.
Shorea guiso.

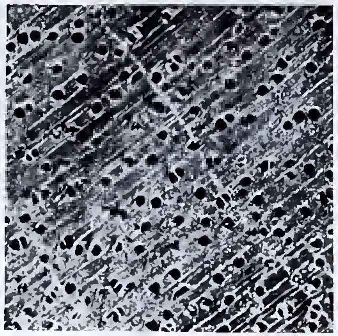

FIG. 51. Red Lauan.
Shorea negrosensis.

FIG. 52. Tanguile.
Shorea polysperma.

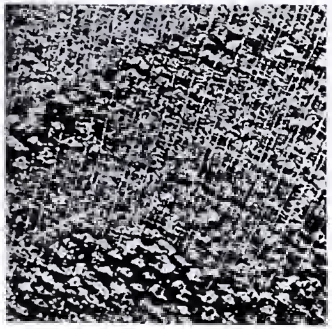

FIG. 53. Narig.
Vatica sp.

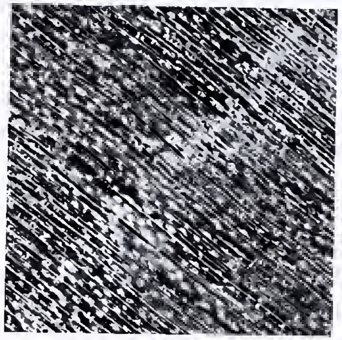

FIG. 54. Aranga.
Homalium luzoniense.

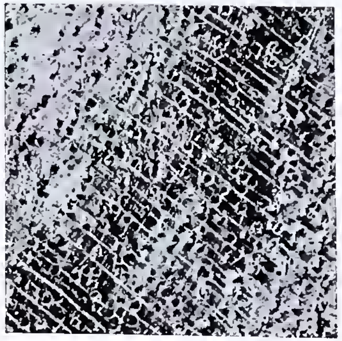

FIG. 55. Binuang.
Octomeles sumatrana.

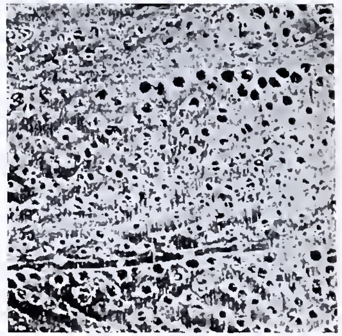

FIG. 56. Batitinan.
Lagerstroemia piriformis.

[Photos by Bureau of Science.]

Plate VII.

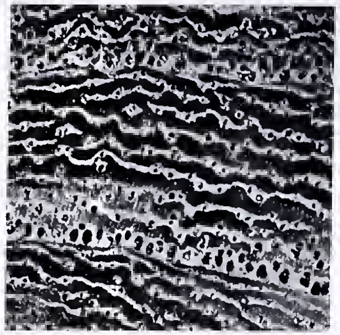

FIG. 57. Banaba.
Lagerstroemia speciosa.

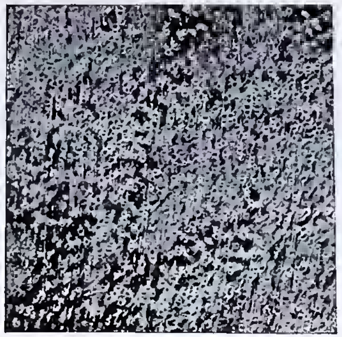

FIG. 58. Pagatpat.
Sonneratia pagatpat.

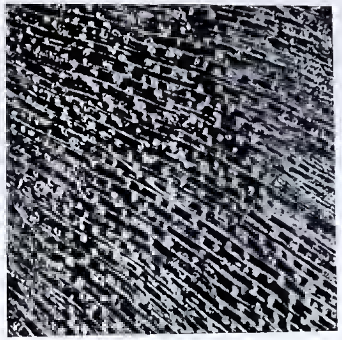

FIG. 59. Busain.
Bruguiera gymnorrhiza.

FIG. 60. Bacauan-gubat.
Carallia integerrima.

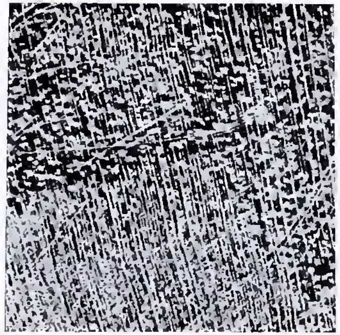

FIG. 61. Tangal.
Ceriops tagal.

FIG. 62. Bacauan-babae.
Rhizophora mucronata.

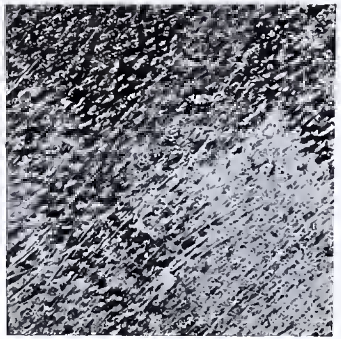

FIG. 63. Tabau.
Lumnitzera littorea.

FIG. 64. Sacat.
Terminalia nitens.

[Photos by Bureau of Science.]

Plate VIII.

Fig. 65. Macaasim.
Eugenia longiflora.

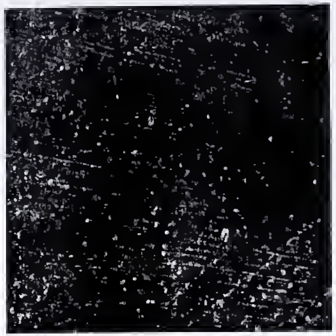

Fig. 66. Mancono.
Xanthostemon verdugonianus.

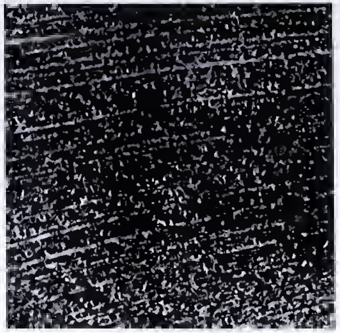

Fig. 67. Malapapaya.
Polyscias nodosa.

Fig. 68. Betis.
Bassia betis.

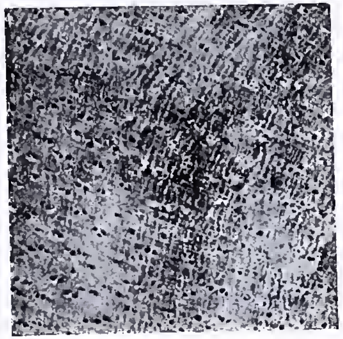

Fig. 69. Nato.
Palaquium lanceolatum.

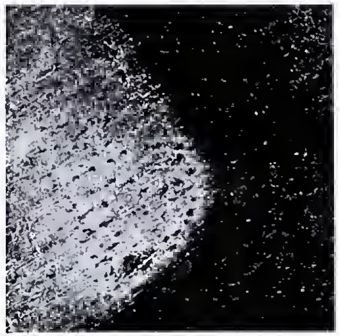

Fig. 70. Ebony.
Maba buxifolia.

Fig. 71. Urung.
Fagraca sp.

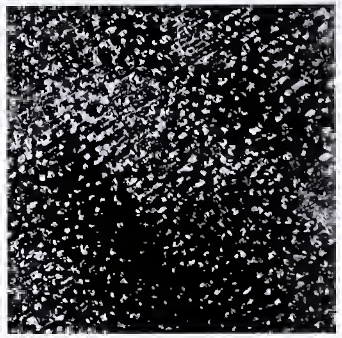

Fig. 72. Batino.
Alstonia macrophylla.

[Photos by Bureau of Science.]

Plate IX.

Fig. 73. Dita.
Alstonia scholaris.

Fig. 74. Lanete.
Wrightia laniti.

Fig. 75. Api-api.
Avicennia officinalis.

Fig. 76. Teak.
Tectona grandis.

Fig. 77. Sasalit.
Vitex aherniana.

Fig. 78. Molave.
Vitex parviflora.

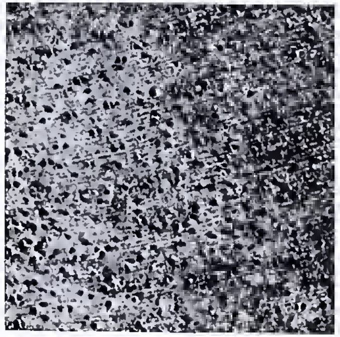

Fig. 79. Bangkal.
Nauclea orientalis.

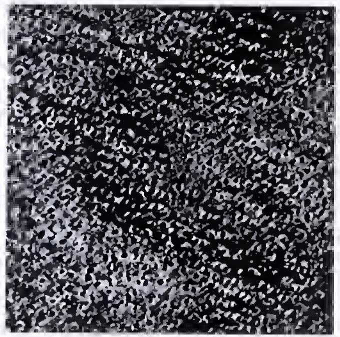

Fig. 80.
Neonauclea bernardoi.

[Photos by Bureau of Science.]

Plate X.

APPENDIXES.

Appendix I.—MECHANICAL PROPERTIES

TABLE I.—*Cross-bending*

Name.	Locality.		Number of tests.	Moisture over 35 per cent. Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).[b]	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch.)
Lauan	Mindanao	Average	38	51.8	0.444	2,630	4,570	6,870	1,464
		Maximum		75	.485	5,340	5,840	7,950	1,820
		Minimum		35.5	.405	1,410	3,160	5,340	975
Do	Zambales	Average	36	63	.478	5,260	6,410	8,040	1,438
		Maximum		86.4	.529	7,450	7,880	9,770	1,740
		Minimum		41.6	.412	2,810	4,510	4,510	1,050
Almon	Occidental Negros.	Average	18	59.2	.464	5,400	6,380	8,260	1,377
		Maximum		70	.52	6,750	7,310	9,430	1,500
		Minimum		49	.378	3,800	4,360	5,980	1,120
Apitong	Mindanao	Average	52	53.9	.62	3,750	5,550	7,350	1,754
		Maximum		81	.715	6,330	8,720	10,550	2,580
		Minimum		36	.56	1,970	3,730	5,540	1,320
Do	Zambales	Average	30	55.8	.679	5,220	6,790	8,910	1,428
		Maximum		84.6	.721	7,030	8,430	10,470	1,740
		Minimum		48.8	.588	2,530	3,230	3,910	900
Do	Negros	Average	11	95.5	.564	5,960	7,060	9,470	1,565
		Maximum		107	.581	7,040	8,300	10,960	1,740
		Minimum		76.8	.55	4,920	6,050	8,040	1,370
Guijo	Ambos Camarines.	Average	27	43.7	.677	6,330	8,660	12,050	1,915
		Maximum		56	.735	8,150	10,200	13,820	2,240
		Minimum		37.2	.629	4,920	7,180	10,380	1,635
Do	Mindoro	Average	49	57.8	.696	6,420	8,780	11,350	1,825
		Maximum		89.8	.806	9,140	11,450	14,200	2,210
		Minimum		41	.596	2,110	4,570	6,210	1,190
Molave	Near Laguna de Bay.	Average	47	45.5	.772	4,870	8,380	10,610	1,503
		Maximum		62	.858	9,150	13,600	14,600	2,000
		Minimum		36.4	.69	1,410	4,360	5,200	895
Do	Ambos Camarines.	Average	29	54.4	.782	6,840	8,640	10,380	1,381
		Maximum		72.5	.825	9,850	11,950	14,380	3,090
		Minimum		43.8	.712	2,100	2,460	3,820	1,050
Yacal	do	Average	21	43.3	.823	7,270	10,160	13,070	2,079
		Maximum		54.2	.906	9,850	11,600	15,350	2,650
		Minimum		35.3	.76	4,920	7,750	10,260	1,680
Narra	Near Laguna de Bay.	Average	11	79	.563	3,000	6,300	8,390	1,509
		Maximum		93	.59	4,500	8,100	11,300	1,850
		Minimum		65	.535	2,110	4,500	5,300	1,130
Do	Cagayan	Average	11	51.8	.63	6,020	7,960	10,220	1,352
		Maximum		81.7	.77	7,730	10,830	13,500	1,630
		Minimum		35.5	.475	4,360	6,050	7,190	1,050
Tanguile	Unknown	Average	8	39.9	.536	5,180	6,780	9,160	1,576
		Maximum		45.4	.565	5,900	7,600	10,210	1,685
		Minimum		35.5	.51	4,640	5,760	7,030	1,380
Do	Zambales	Average	27	47.7	.457	4,010	4,980	6,380	1,241
		Maximum		80	.54	5,620	7,170	9,450	1,660
		Minimum		38.9	.405	2,110	2,110	3,040	950
Tanguile-balakbakan	Occidental Negros.	Average	15	58.1	.509	5,030	6,280	8,670	1,348
		Maximum		62.5	.53	5,900	6,900	9,330	1,530
		Minimum		53	.479	2,950	5,350	7,920	1,180
Sacat	Lamao Forest Reserve, Bataan.	Average	8	48.5	.561	3,340	5,030	6,960	1,584
		Maximum		54.4	.585	4,220	5,380	7,670	1,710
		Minimum		45.2	.54	2,110	4,120	4,840	1,340

[a] Tables abstracted from Bulletin No. 4 of the Bureau of Forestry (1907) by Rolland Gardner.

[b] The apparent elastic limit was used in order to compare tests of native woods with similar tests of American woods. See table of tests, pp. 233, 234.

OF THIRTY-FOUR PHILIPPINE WOODS.[a]

strength of Philippine timber.

Moisture 20 to 35 per cent.							Moisture under 20 per cent.								
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
21	29.8 35 20	0.442 .47 .40	3,350 6,190 1,550	5,300 7,740 3,520	7,200 8,920 4,220	1,462 1,790 1,050	14	10.4 17.5 3	0.457 .488 .404	5,730 10,550 3,390	8,240 12,640 5,480	9,760 14,250 7,020	1,653 1,840 1,395	73	0.446 .488 .40
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	36	.478 .529 .412
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	18	.464 .52 .378
10	26.8 33.6 22	.699 .74 .658	6,190 9,150 4,220	8,220 9,850 6,320	10,230 11,640 8,600	2,033 2,550 1,710	13	14 19.8 9	.706 .825 .618	7,340 10,550 4,920	9,760 12,480 6,050	11,620 15,600 6,050	2,144 2,425 1,900	75	.645 .825 .56
1	20.8 20.8 20.8	.93 .93 .93	2,950 2,950 2,950	4,150 4,150 4,150	5,100 5,100 5,100	1,000 1,000 1,000	-----	-----	-----	-----	-----	-----	-----	31	.687 .93 .588
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	11	.564 .581 .55
15	26.6 35 20.3	.72 .776 .673	7,820 9,850 4,920	9,940 12,380 7,800	12,860 14,600 10,540	2,077 2,370 1,660	13	13.7 18.6 7	.759 .82 .718	10,080 12,650 7,730	12,850 19,700 8,940	15,150 21,500 11,900	2,158 2,480 1,740	55	.708 .82 .629
1	23.3 23.3 23.3	.724 .724 .724	7,740 7,740 7,740	9,150 9,150 9,150	12,650 12,650 12,650	2,110 2,110 2,110	-----	-----	-----	-----	-----	-----	-----	50	.697 .806 .596
11	31.8 35 24.8	.803 .848 .725	5,010 7,030 3,520	9,000 10,700 7,740	10,190 12,150 9,530	1,602 1,950 1,400	9	10.4 19.5 3.5	.824 .88 .79	8,240 10,550 4,920	8,580 13,600 4,920	8,580 13,600 4,920	1,614 1,980 1,240	67	.785 .88 .69
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42	29.6 34.3 21.5	.846 .94 .77	8,180 11,250 4,220	10,700 13,600 5,480	14,090 17,650 7,700	2,368 2,870 1,680	17	15.6 19.8 11.4	.848 .90 .81	9,650 12,230 6,680	12,130 17,480 9,140	15,690 21,800 13,580	2,583 3,000 1,844	80	.843 .94 .76
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7	26.9 32.7 22.9	.508 .56 .438	5,650 8,430 2,110	6,570 9,850 3,090	7,380 11,020 3,460	1,462 1,710 870	13	9.6 13.8 4.6	.487 .531 .384	6,440 10,550 2,810	7,070 10,680 2,810	7,560 11,730 2,960	1,510 1,670 1,050	31	.54 .77 .384
12	30.6 34.6 21.8	.487 .524 .38	5,310 6,740 4,220	6,960 7,600 6,190	9,110 10,230 7,030	1,456 1,685 1,050	16	13.7 18.7 5	.422 .58 .355	6,440 9,150 4,500	7,380 11,400 4,920	8,360 12,560 4,920	1,232 1,610 976	36	.469 .58 .355
1	34.5 34.5 34.5	.54 .54 .54	6,050 6,050 6,050	6,330 6,330 6,330	7,700 7,700 7,700	1,320 1,320 1,320	19	9.7 18.4 1.6	.535 .606 .478	6,430 10,550 2,110	7,470 11,520 2,110	8,570 13,220 2,300	1,594 1,950 1,120	47	.491 .606 .405
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TABLE I.—*Cross-bending strength*

Name.	Locality.		Moisture over 35 per cent.						
			Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).[a]	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).
Sacat	Tarlac	Average	42	55.2	0.60	5,800	7,050	9,300	1,569
		Maximum		82.6	.657	7,740	9,000	12,450	1,920
		Minimum		35.3	.478	2,250	2,810	3,120	920
Ipil	Ambos Camarines.	Average	19	52.7	.79	4,360	6,690	7,960	1,295
		Maximum		76.1	.872	5,620	9,420	11,680	1,680
		Minimum		36.1	.68	2,670	5,620	5,620	1,000
Do	Mindoro	Average	44	63.1	.67	5,450	7,430	9,410	1,226
		Maximum		106	.77	9,150	10,820	13,640	1,840
		Minimum		35.6	.56	1,480	2,050	2,050	550
Do	Palawan	Average	41	52.2	.807	9,170	11,210	13,520	1,953
		Maximum		60.1	.867	12,220	13,750	17,000	2,210
		Minimum		46.6	.75	2,110	2,810	6,330	1,420
Dungon	Ambos Camarines.	Average	6	42.2	.824	5,660	7,400	11,770	1,680
		Maximum		66.4	.895	7,880	9,570	14,980	2,080
		Minimum		35.2	.723	1,410	2,540	4,370	1,050
Do	Masbate	Average	3	36.3	.827	4,730	6,420	10,250	1,593
		Maximum		37.2	.845	4,920	7,030	11,400	1,790
		Minimum		35.5	.816	4,360	5,620	8,640	1,470
Do.[b]	Mindanao	Average	21	49.4	.668	4,520	5,740	7,870	1,317
		Maximum		81.6	.707	5,900	6,890	9,520	1,690
		Minimum		35.5	.636	2,810	4,150	5,510	920
Malasantol	Unknown	Average	21	66.2	.633	4,500	6,480	8,690	1,518
		Maximum		84.5	.689	6,330	7,380	10,040	1,670
		Minimum		35.4	.608	2,810	5,280	5,870	1,420
Supa	do	Average	5	37.3	.673	6,410	8,180	10,050	1,435
		Maximum		40.8	.692	8,440	8,870	11,150	1,530
		Minimum		35.6	.61	4,920	7,180	8,630	1,370
Do	Tayabas	Average	12	38.7	.755	4,890	7,170	8,700	1,415
		Maximum		46.7	.843	6,720	8,920	10,500	1,650
		Minimum		35.1	.70	2,810	4,920	6,490	1,160
Balacat	Lamao Forest Reserve, Bataan.	Average	9	56.1	.517	5,120	6,280	8,540	1,293
		Maximum		86	.57	6,190	6,750	9,200	1,450
		Minimum		45.7	.478	4,220	5,780	7,730	1,105
Do	Tarlac	Average	21	45.4	.56	5,210	6,200	7,780	1,221
		Maximum		59.8	.62	6,330	7,390	9,370	1,420
		Minimum		36.5	.515	3,520	3,940	4,790	870
Macaasim	Unknown	Average	35	68.4	.695	4,370	6,120	8,660	1,416
		Maximum		87.9	.734	8,440	8,790	10,880	1,750
		Minimum		36.3	.667	1,546	3,550	5,180	1,070
Calantas	Albay	Average	15	75.4	.357	3,000	4,240	5,650	961
		Maximum		94	.379	3,949	4,920	6,600	1,185
		Minimum		61	.336	1,970	3,100	4,400	738
Do	Mindoro	Average	10	57.3	.511	3,560	4,900	6,250	940
		Maximum		67	.54	5,620	6,180	7,950	1,160
		Minimum		38	.492	2,110	3,020	3,060	580
Tindalo	Unknown	Average	6	40.4	.747	8,090	10,770	15,000	2,226
		Maximum		44.6	.77	9,140	11,940	16,980	2,340
		Minimum		35.8	.734	6,330	8,430	12,300	2,050
Do	Ambos Camarines.	Average	12	44.7	.808	7,070	9,005	11,330	1,588
		Maximum		55	.86	10,400	12,400	14,200	1,750
		Minimum		37.7	.757	5,350	5,350	8,600	1,130

[a] The apparent elastic limit was used in order to compare tests of native woods with similar tests of American woods. See table of tests, pp. 233, 234.

[b] This is not the wood commonly known as dungon, but is often sold under that name.

of Philippine timber—Continued.

Moisture 20 to 35 per cent.							Moisture under 20 per cent.								
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
10	24.2	0.606	5,930	7,290	9,050	1,637	16	12.8	0.664	8,350	9,610	11,440	1,886	68	0.616
	35	.677	7,600	9,140	12,470	1,900		19.3	.70	10,540	12,230	15,600	2,080		.70
	20.2	.485	2,110	2,390	4,220	1,160		4.2	.622	4,220	4,500	4,920	1,710		.478
14	25.8	.783	5,580	6,640	7,900	1,470	8	18.1	.816	6,000	6,440	6,980	1,383	41	.792
	34.6	.83	7,730	9,420	12,600	1,730		19.6	.99	7,580	7,740	9,040	1,630		.99
	21	.685	3,520	5,070	5,620	1,260		16	.713	4,780	4,780	4,780	1,180		.68
2	34.5	.743	7,530	9,520	13,040	1,750								46	.673
	34.5	.77	7,740	9,700	13,520	1,840	---	------	------	------	------	------	------		.77
	34.4	.717	7,320	9,350	12,560	1,660									.56
														41	.807
---	------	------	------	------	------	------	---	------	------	------	------	------	------		.867
															.75
40	26.4	.878	6,870	8,940	13,510	1,947	26	11.6	.845	10,160	13,460	17,110	2,209	72	.857
	33.9	.924	9,850	11,400	16,900	2,260		17.6	.985	14,760	18,300	22,700	2,500		.985
	20	.788	3,800	5,910	7,900	1,240		6.5	.796	5,770	7,180	9,770	1,500		.723
21	30.1	.854	4,960	6,910	10,600	1,442								24	.85
	34.5	.89	6,330	8,440	13,150	1,900	---	------	------	------	------	------	------		.89
	26.3	.822	3,520	4,220	7,260	1,050									.816
2	30.7	.685	5,060	6,540	9,070	1,525								23	.669
	31.9	.69	5,200	7,040	9,200	1,530	---	------	------	------	------	------	------		.707
	29.5	.68	4,920	6,050	8,940	1,520									.636
2	26.3	.663	5,840	7,180	10,310	1,595	5	12.1	.694	5,760	7,630	10,880	1,754	28	.646
	27.1	.68	6,330	7,600	10,550	1,610		18.2	.712	7,730	9,000	13,540	2,290		.712
	25.6	.646	5,350	6,760	10,080	1,580		5.3	.66	3,520	4,220	4,800	1,320		.608
23	29.3	.711	7,360	10,070	12,390	1,907	18	14.5	.722	10,060	11,670	13,100	1,863	46	.711
	34.4	.835	11,250	12,660	16,450	2,870		19.7	.808	15,500	15,800	16,850	2,280		.835
	20	.644	4,220	7,450	9,140	1,370		10.2	.625	7,040	7,730	7,810	1,475		.61
49	30.1	.827	5,280	7,520	9,050	1,510								61	.813
	34	.955	9,250	11,010	13,220	1,930	---	------	------	------	------	------	------		.955
	26.6	.712	1,680	2,410	3,230	750									.70
														9	.517
---	------	------	------	------	------	------	---	------	------	------	------	------	------		.57
															.478
7	26.6	.579	5,710	6,060	7,010	1,204	32	10.4	.589	6,050	7,600	8,270	1,271	60	.578
	30	.602	6,330	8,090	10,000	1,310		18.7	.66	8,440	11,250	11,720	1,520		.66
	24.1	.561	3,800	4,220	4,690	1,110		2.6	.54	4,220	4,670	4,670	1,080		.515
8	26.7	.77	5,200	8,130	10,560	1,778	4	15.7	.79	6,260	9,650	11,010	1,825	47	.717
	30.4	.81	5,910	10,400	13,130	1,950		19.1	.82	8,450	11,980	13,240	2,030		.82
	23	.734	3,870	6,330	8,940	1,630		12.3	.76	3,240	6,690	7,750	1,530		.667
							4	11.1	.363	5,300	7,260	8,980	1,255	19	.358
---	------	------	------	------	------	------		14.6	.37	6,320	8,160	9,300	1,340		.379
								8.6	.355	4,220	6,320	8,670	1,160		.336
8	28.9	.547	3,460	4,500	5,210	801								18	.527
	34.5	.583	4,920	6,330	7,200	1,050	---	------	------	------	------	------	------		.583
	23.7	.505	1,410	1,410	1,610	580									.492
4	28.9	.787	9,490	12,750	16,570	2,182								10	.763
	35.5	.864	11,250	14,340	17,650	2,230	---	------	------	------	------	------	------		.864
	23.3	.756	8,440	11,380	15,100	2,160									.734
16	26.6	.802	5,800	7,470	8,680	1,445	1	19.5	.808	7,180	9,140	11,200	1,570	29	.805
	33.4	.866	9,710	11,250	12,830	1,580		19.5	.808	7,180	9,140	11,200	1,570		.866
	20.6	.72	2,890	2,890	3,030	1,180		19.5	.808	7,180	9,140	11,200	1,570		.72

TABLE I.—*Cross-bending strength*

Name.	Locality.		Moisture over 35 per cent. Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).[a]	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).
Tindalo	Masbate	Average	10	59	0.77	5,290	7,690	11,200	1,536
		Maximum		71.8	.813	7,460	9,480	13,240	1,710
		Minimum		50.7	.70	2,950	4,500	8,420	1,160
Amugis	Mindoro	Average	31	46.1	.692	4,490	6,800	9,780	1,697
		Maximum		61.1	.76	9,110	9,300	12,670	2,160
		Minimum		35.7	.621	1,548	3,520	5,630	1,160
Do	Palawan	Average	8	53.9	.675	6,730	8,020	11,040	1,735
		Maximum		64.1	.753	8,000	8,850	11,680	1,840
		Minimum		49.5	.613	6,320	6,880	9,620	1,530
Acle	Tarlac	Average	41	92.5	.632	3,920	6,000	7,270	1,069
		Maximum		103	.707	5,280	7,730	8,920	1,395
		Minimum		77	.598	2,460	4,780	5,250	895
Do	Zambales	Average	6	96.8	.579	5,900	7,010	9,080	1,213
		Maximum		111	.604	7,030	8,720	11,560	1,360
		Minimum		83.6	.553	4,080	4,570	5,810	1,080
Betis	Tayabas	Average	7	38.1	.849	5,780	8,460	11,910	1,768
		Maximum		42.5	.882	7,380	10,130	13,680	2,055
		Minimum		35.1	.82	3,160	6,330	10,010	1,293
Do	Ambos Camarines.	Average	30	61.6	.725	3,670	5,620	7,450	2,035
		Maximum		100	.798	5,240	7,750	9,340	2,400
		Minimum		45	.615	2,090	2,830	3,660	1,050
Bansalagin	Unknown	Average	18	46.2	.841	6,820	9,420	11,740	1,702
		Maximum		57.8	.883	8,440	10,550	14,150	2,050
		Minimum		40	.784	3,800	7,310	9,510	1,480
Palo Maria	Zambales	Average	24	56	.623	5,840	7,040	8,930	1,461
		Maximum		105	.708	8,790	9,500	12,450	1,680
		Minimum		36.6	.488	2,950	4,080	5,500	810
Batitinan	Unknown	Average	10	54.4	.777	4,540	6,350	9,320	1,427
		Maximum		61.2	.795	5,620	7,600	10,600	1,630
		Minimum		49.1	.76	2,540	4,080	5,900	1,200
Aranga	Ambos Camarines.	Average	--	------	------	------	------	------	------
		Maximum							
		Minimum							
Banuyo	Masbate	Average	16	82	.522	2,900	4,170	5,140	881
		Maximum		115	.572	5,070	6,880	7,390	1,120
		Minimum		47.7	.455	1,400	2,860	4,080	575
Red Lauan	Occidental Negros.	Average	15	75.8	.406	4,040	4,690	7,100	1,201
		Maximum		84	.43	4,920	5,620	7,900	1,370
		Minimum		65	.371	2,110	2,250	2,610	870
Palosapis	Laguna	Average	20	67.7	.399	4,070	5,320	6,760	1,133
		Maximum		91	.456	4,920	6,330	8,300	1,420
		Minimum		48	.343	3,510	3,510	3,510	870
Malugay	Mindoro	Average	18	57.2	.635	4,780	6,930	10,280	1,627
		Maximum		72	.713	6,680	8,570	12,700	1,920
		Minimum		48.2	.553	2,810	5,200	6,900	1,290
Sasalit	Zambales	Average	--	------	------	------	------	------	------
		Maximum							
		Minimum							
Liusin	Bataan	Average	14	60.9	.71	5,430	8,120	11,360	1,896
		Maximum		63	.73	7,720	10,200	14,150	2,180
		Minimum		57.6	.70	2,390	5,900	7,160	1,340

[a] The apparent elastic limit was used in order to compare tests of native woods with similar tests of American woods. See table of tests, pp. 233, 234.

of Philippine timber—Continued.

Moisture 20 to 35 per cent.							Moisture under 20 per cent.								
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
8	22.5	0.785	6,370	8,160	9,050	1,273	5	18.9	0.766	5,990	8,220	8,920	1,180	18	0.772
	24.6	.788	7,020	8,300	10,000	1,320		19.9	.808	7,450	9,770	11,020	1,370		.813
	20.3	.784	5,340	8,080	8,080	1,180		17.7	.68	4,920	7,170	7,680	950		.68
1	33.6	.75	5,620	8,590	12,050	1,760								32	.694
	33.6	.75	5,620	8,590	12,050	1,760	---	---	---	---	---	---	---		.76
	33.6	.75	5,620	8,590	12,050	1,760									.621
														8	.675
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															.613
5	27.9	.635	5,630	6,830	7,550	1,138	1	15.7	.684	3,660	4,920	5,400	880	20	.635
	34.5	.67	6,330	8,870	9,750	1,210		15.7	.684	3,660	4,920	5,400	880		.707
	21	.607	4,640	5,340	5,980	1,060		15.7	.684	3,660	4,920	5,400	880		.598
														6	.579
---	---	---	---	---	---	---	---	---	---	---	---	---	---		.604
															.553
13	31.8	.86	4,930	8,090	10,850	1,593								20	.856
	34.4	.886	7,380	10,550	14,060	1,950	---	---	---	---	---	---	---		.886
	27.1	.82	2,110	5,380	7,030	1,080									.82
1	34	.806	4,190	5,660	7,580	2,020								31	.728
	34	.806	4,190	5,660	7,580	2,020	---	---	---	---	---	---	---		.806
	34	.806	4,190	5,660	7,580	2,020									.615
1	33.3	.88	6,750	7,030	7,740	1,740	6	15.5	.87	8,670	11,870	14,480	2,311	25	.85
	33.3	.88	6,750	7,030	7,740	1,740		17	.905	10,250	13,350	18,200	2,530		.905
	33.3	.88	6,750	7,030	7,740	1,740		14.3	.85	6,330	8,780	12,400	2,100		.784
														24	.623
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															.488
							4	5	.836	6,850	8,400	9,630	1,655	14	.795
---	---	---	---	---	---	---		6.2	.85	8,860	11,100	12,300	1,910		.85
								4.1	.821	4,920	5,770	7,030	1,450		.76
19	31.4	.826	7,970	11,070	13,440	2,061	26	5.6	.882	12,530	16,230	17,920	2,419	45	.859
	34.8	.86	10,200	12,660	16,900	2,350		7.5	.942	16,880	21,350	24,450	2,800		.942
	29.3	.796	4,790	8,860	10,300	1,740		2.9	.832	7,740	9,850	11,630	2,000		.796
1	29.3	.52	4,220	5,340	5,940	1,105	3	17	.538	4,030	5,530	6,000	1,070	20	.525
	29.3	.52	4,220	5,340	5,940	1,105		18.9	.546	5,200	6,040	6,270	1,105		.572
	29.3	.52	4,220	5,340	5,940	1,105		13.4	.523	2,810	5,200	5,800	1,000		.455
														15	.406
---	---	---	---	---	---	---	---	---	---	---	---	---	---		.43
															.371
														20	.399
---	---	---	---	---	---	---	---	---	---	---	---	---	---		.456
															.343
7	22.4	.656	5,790	7,530	10,530	1,732	15	12	.686	7,730	11,220	13,980	1,788	40	.658
	26.4	.693	6,900	8,080	11,740	2,150		19.8	.75	9,850	14,900	19,830	2,180		.75
	21	.625	3,800	6,900	8,850	1,530		7.5	.62	4,090	6,810	10,040	1,480		.553
21	26.4	.901	9,990	11,420	14,050	2,120	18	12.4	.839	8,010	10,260	11,310	1,837	39	.872
	30.2	.995	13,350	15,480	18,720	2,480		19.2	.87	12,650	13,980	15,820	2,270		.995
	22	.742	7,030	7,460	8,770	1,240		9	.807	4,080	4,220	5,310	1,120		.742
														14	.71
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															.70

TABLE I.—*Cross-bending strength*

Name.	Locality.		Moisture over 35 per cent.						
			Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).[a]	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).
Lumbayao	Basilan Island, Moro Province.	Average	2	37.1	0.545	5,620	6,460	7,790	1,160
		Maximum		38.7	.56	6,740	6,890	8,060	1,210
		Minimum		35.5	.53	4,500	6,040	7,520	1,110
Agoho	Tarlac	Average	28	45.9	.704	8,400	9,730	11,920	1,696
		Maximum		57.4	.762	11,820	13,220	15,950	2,050
		Minimum		35.4	.62	1,970	2,670	3,160	870
Do	do	Average							
		Maximum							
		Minimum							
Do	do	Average							
		Maximum							
		Minimum							
Mangachapuy	Albay	Average	5	51.3	.59	6,070	7,430	8,600	1,528
		Maximum		69	.622	7,880	8,290	10,320	1,710
		Minimum		36.2	.55	3,240	5,620	7,020	1,260
Do	do	Average							
		Maximum							
		Minimum							
Dao	Mindoro	Average							
		Maximum							
		Minimum							
Cupang	Palawan	Average	14	96.2	.285	2,460	3,090	3,580	779
		Maximum		129	.368	3,380	3,940	4,530	1,100
		Minimum		69	.259	1,410	2,250	2,550	160

[a] The apparent elastic limit was used in order to compare tests of native woods with similar tests of American woods. See table of tests, pp. 233, 234.

of Philippine timber—Continued.

Moisture 20 to 35 per cent.							Moisture under 20 per cent.								
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Total number of tests.	**Specific gravity of dry wood, all tests.**
30	26.1 33.9 20.5	0.552 .603 .483	6,550 8,870 3,510	7,620 10,000 4,150	10,090 12,180 4,430	1,416 1,630 950	22	12.7 19.5 5.3	0.584 .671 .53	7,800 10,140 4,220	9,110 12,380 4,220	11,390 14,920 7,810	1,570 1,870 1,340	54	0.565 .671 .488
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15	26 34.2 20	.854 .905 .80	6,620 9,000 4,080	8,240 10,980 5,630	11,730 16,100 8,370	1,775 2,130 1,420	-----	-----	-----	-----	-----	-----	-----	15	.854 .905 .80
-----	-----	-----	-----	-----	-----	-----	4	17.6 19.7 16	.942 .954 .93	8,620 9,150 7,740	11,290 12,670 10,280	14,660 15,420 14,250	1,970 2,160 1,630	4	.942 .954 .93
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5	.59 .622 .55
14	30.8 34.8 23.5	.725 .75 .708	9,030 10,400 3,240	10,780 11,960 4,220	14,190 16,450 5,830	1,715 2,030 920	-----	-----	-----	-----	-----	-----	-----	14	.725 .75 .708
2	32.5 34 31	.631 .633 .63	6,390 6,600 6,190	7,230 8,150 6,320	8,550 9,440 7,660	1,740 1,740 1,740	-----	-----	-----	-----	-----	-----	-----	2	.631 .633 .63
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TABLE II.—*Compressive strength along*

Name.	Locality.		Moisture over 35 per cent. Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Lauan	Mindanao	Average Maximum Minimum	67	52.4 73 38.4	0.444 .485 .408	3,840 5,490 3,262
Do	Zambales	Average Maximum Minimum	70	59.5 76 35.2	.478 .529 .412	4,180 4,980 3,220
Almon	Occidental Negros	Average Maximum Minimum	34	57.6 71.6 46.1	.464 .52 .378	4,500 5,170 3,140
Apitong	Mindanao	Average Maximum Minimum	98	53 71.8 36	.617 .715 .56	4,350 5,740 3,350
Do	Zambales	Average Maximum Minimum	60	53.4 93 46.4	.679 .721 .588	5,010 5,710 2,810
Do	Occidental Negros	Average Maximum Minimum	20	93.2 102 83	.564 .581 .55	4,750 5,400 3,550
Guijo	Ambos Camarines	Average Maximum Minimum	50	41.8 59.6 36	.675 .73 .629	6,070 6,610 5,180
Do	Mindoro	Average Maximum Minimum	98	55.7 79.6 40.9	.697 .806 .596	6,070 7,300 3,660
Molave	Near Laguna de Bay	Average Maximum Minimum	78	46.4 66 37	.772 .85 .69	6,680 8,470 4,770
Do	Ambos Camarines	Average Maximum Minimum	50	50.5 61.5 40.3	.784 .822 .712	6,530 8,300 3,900
Yacal	do	Average Maximum Minimum	34	46.7 75 38.6	.828 .85 .77	7,490 8,400 6,200
Narra	Near Laguna de Bay	Average Maximum Minimum	20	77.7 93 66.5	.563 .69 .535	5,780 6,900 4,180
Do	Cagayan	Average Maximum Minimum	18	55.9 75.5 35.5	.619 .68 .482	5,300 6,530 3,770
Tanguile	Unknown	Average Maximum Minimum	18	40.5 47.4 35.2	.53 .565 .47	4,750 5,270 3,650
Do	Zambales	Average Maximum Minimum	54	44.1 58.6 35.6	.46 .54 .405	3,980 4,780 3,050
Tanguile-balakbakan	Occidental Negros	Average Maximum Minimum	28	56.4 59.5 49.3	.509 .53 .479	4,620 4,960 3,910
Sacat	Bataan	Average Maximum Minimum	14	49.8 53.8 46.2	.561 .585 .54	4,530 4,740 4,280
Do	Tarlac	Average Maximum Minimum	74	53.1 89.7 35.2	.60 .657 .478	5,260 9,150 3,140
Ipil	Ambos Camarines	Average Maximum Minimum	36	52.9 78.7 43.5	.796 .872 .714	5,650 6,390 4,980

the grain of Philippine timber.

Moisture 20 to 35 per cent.				Moisture under 20 per cent.				Total number of tests.	Specific gravity of dry wood, all tests.
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).		
40	30.5 35 25	0.44 .47 .40	4,040 4,550 3,470	32	12.4 19.4 3.3	0.458 .488 .404	6,180 9,270 4,730	139	0.448 .488 .40
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24	27.2 34 20	.711 .825 .664	5,740 6,770 4,740	28	14.4 19.4 7.8	.688 .735 .618	7,250 9,400 5,270	150	.645 .825 .56
----------	----------	----------	----------	2	15.2 15.2 15.2	.93 .93 .93	4,190 4,220 4,160	62	.687 .93 .588
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24	28.8 35 23.2	.719 .76 .673	6,160 7,220 4,900	36	14.6 19.8 7.5	.748 .82 .68	7,940 11,400 3,980	110	.708 .82 .629
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20	29.7 34.6 20.2	.794 .858 .725	7,080 8,800 6,100	17	12.7 18.8 5.2	.818 .88 .728	8,330 10,300 6,800	115	.783 .88 .69
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94	29.5 35 21.8	.832 .94 .76	8,340 9,510 6,250	29	13.4 18.1 10.7	.849 .90 .814	9,220 11,280 7,580	157	.843 .94 .76
----------	----------	----------	----------	----------	----------	----------	----------	20	.563 .59 .535
18	28.5 34.2 21.1	.534 .77 .438	5,290 7,060 4,160	24	7.5 9.7 4.8	.484 .531 .384	6,740 8,600 4,540	60	.54 .77 .384
22	30.6 35 27.2	.485 .52 .355	5,030 5,450 3,752	32	13.7 19.9 8.8	.424 .58 .376	5,230 6,521 3,825	72	.469 .58 .355
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22	26.6 34.8 20	.592 .677 .485	5,500 5,910 3,990	38	12.4 19.7 4.2	.661 .70 .601	7,140 9,020 4,970	134	.616 .70 .478
30	25.9 31.7 21.6	.779 .855 .68	6,250 7,600 4,280	16	17.7 19.9 14.8	.807 .99 .713	6,570 8,020 3,650	82	.792 .99 .68

TABLE II.—*Compressive strength along the*

Name.	Locality.		Moisture over 35 per cent. Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Ipil	Mindoro	Average	84	60.4	0.666	5,450
		Maximum		89	.75	7,150
		Minimum		37.5	.56	2,390
Do	Palawan	Average	79	51.4	.807	8,090
		Maximum		61.2	.867	9,470
		Minimum		44.8	.75	5,350
Dungon	Ambos Camarines	Average	6	44.1	.803	6,160
		Maximum		58	.846	6,520
		Minimum		37.1	.723	5,900
Do	Masbate	Average	6	36.9	.825	4,540
		Maximum		37.5	.84	5,030
		Minimum		36.2	.816	3,830
Do [a]	Mindanao	Average	38	50.7	.669	4,000
		Maximum		82	.707	4,740
		Minimum		35.5	.636	3,080
Malasantol	Unknown	Average	40	64.4	.631	4,660
		Maximum		86	.68	5,410
		Minimum		37.4	.608	3,390
Supa	do	Average	8	36.1	.677	6,480
		Maximum		36.3	.692	7,030
		Minimum		36	.644	5,750
Do	Tayabas	Average	10	37.2	.746	5,090
		Maximum		41.6	.855	6,090
		Minimum		35.1	.70	3,770
Balacat	Lamao Forest Reserve, Bataan.	Average	16	52.6	.517	4,020
		Maximum		61.6	.57	4,510
		Minimum		39.5	.478	3,540
Do	Tarlac	Average	40	44.7	.56	4,150
		Maximum		63	.62	4,710
		Minimum		36.8	.515	2,920
Macaasim	Unknown	Average	76	63.9	.703	4,350
		Maximum		81.5	.81	6,260
		Minimum		35.2	.667	2,610
Calantas	Albay	Average	28	77.3	.357	2,960
		Maximum		89.6	.379	3,450
		Minimum		62.9	.336	2,330
Do	Mindoro	Average	18	57.3	.51	3,810
		Maximum		64.7	.54	4,960
		Minimum		46	.492	3,230
Tindalo	Unknown	Average	12	41.9	.747	7,400
		Maximum		44.8	.77	9,150
		Minimum		38.3	.734	5,620
Do	Ambos Camarines	Average	23	43.9	.80	7,140
		Maximum		58.1	.86	8,960
		Minimum		37	.72	5,850
Do	Masbate	Average	20	56.7	.77	5,930
		Maximum		70.1	.813	7,030
		Minimum		50.7	.70	4,270
Amugis	Mindoro	Average	54	45.2	.692	5,210
		Maximum		57.8	.76	6,490
		Minimum		36	.621	2,660
Do	Palawan	Average	14	54.1	.675	5,640
		Maximum		61.6	.753	6,150
		Minimum		48.1	.613	4,660
Acle	Tarlac	Average	27	84.5	.631	4,550
		Maximum		101	.707	5,440
		Minimum		39.2	.598	3,970

[a] This is not the wood commonly known as dungon, but is often sold under that name.

grain of Philippine timber—Continued.

Moisture 20 to 35 per cent.				Moisture under 20 per cent.					
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
4	32.5 33.4 31.5	0.77 .77 .77	6,030 6,470 5,530	2	19.8 19.8 19.8	0.77 .77 .77	6,540 6,570 6,510	90	0.673 .77 .56
----	----	----	----	----	----	----	----	79	.807 .867 .75
54	25.2 34 20	.88 .985 .788	6,440 7,970 4,050	48	10.7 16.4 8	.839 .882 .796	9,420 11,970 6,410	108	.858 .985 .723
40	29.5 34.8 25.1	.854 .89 .822	4,690 6,670 3,460	----	----	----	----	46	.85 .89 .816
6	32.6 35 29	.67 .69 .657	4,600 5,200 4,090	----	----	----	----	44	.669 .707 .636
4	30.7 34.3 27.2	.684 .689 .679	4,840 5,040 4,660	10	13.5 17.1 10	.694 .712 .66	6,580 8,040 5,140	54	.646 .712 .608
42	30.2 33.4 26	.711 .835 .61	7,100 8,510 5,790	42	14.5 19.5 8.3	.713 .808 .625	8,700 10,340 7,046	92	.711 .835 .61
112	28.3 34.7 22.5	.819 .955 .712	5,980 7,700 4,000	----	----	----	----	122	.813 .955 .70
----	----	----	----	----	----	----	----	16	.517 .57 .478
12	24.9 30.7 20	.588 .66 .561	4,650 5,320 3,770	66	9.8 19.2 2.2	.587 .638 .54	5,530 7,590 4,020	118	.578 .66 .515
10	26.2 30.5 20	.776 .78 .774	5,880 6,600 4,960	6	17.1 18 15.7	.793 .82 .76	6,860 7,650 5,980	92	.717 .82 .667
----	----	----	----	8	9.7 12.8 7.1	.363 .37 .355	4,420 4,830 3,230	36	.358 .379 .336
12	26.3 32.2 23.8	.537 .583 .505	3,820 4,320 3,360	6	12.5 19.1 9.1	.557 .573 .531	3,520 4,360 2,890	36	.527 .583 .492
8	28.8 32.4 23.6	.787 .864 .756	8,770 9,680 6,890	----	----	----	----	20	.768 .864 .734
26	27.4 32.7 22.5	.806 .866 .742	7,310 9,040 3,530	6	16.9 17.6 15.7	.819 .83 .802	7,710 8,650 7,040	55	.805 .866 .72
8	22 23 20.1	.753 .788 .68	6,340 7,350 5,150	8	18.6 19.4 16.9	.794 .808 .784	6,780 7,660 5,950	36	.772 .813 .68
6	32.9 34.8 30	.707 .75 .641	4,920 6,140 3,980	----	----	----	----	60	.693 .76 .621
----	----	----	----	----	----	----	----	14	.675 .753 .613
10	30.2 34 25	.647 .684 .607	5,050 5,820 4,400	----	----	----	----	37	.635 .707 .598

TABLE II.—*Compressive strength along the*

Name.	Locality.		Moisture over 35 per cent. Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Acle	Zambales	Average	12	94.9	0.579	5,330
		Maximum		106	.604	5,880
		Minimum		81	.553	4,900
Betis	Tayabas	Average	14	38.2	.854	6,540
		Maximum		42.7	.882	7,540
		Minimum		31.6	.82	5,640
Do	Ambos Camarines	Average	60	59.5	.725	4,330
		Maximum		79.3	.798	4,930
		Minimum		42.8	.615	3,380
Bansalagin	Unknown	Average	34	43	.841	6,960
		Maximum		53.6	.88	8,140
		Minimum		35.1	.784	5,410
Palo Maria	Zambales	Average	40	50.2	.618	4,770
		Maximum		103	.704	6,220
		Minimum		35.1	.488	3,150
Batitinan	Unknown	Average	18	54.9	.777	4,650
		Maximum		61.6	.795	5,180
		Minimum		48.5	.76	3,950
Aranga	Ambos Camarines	Average	----	----	----	----
		Maximum				
		Minimum				
Banuyo	Masbate	Average	30	77.9	.527	3,290
		Maximum		110	.572	4,470
		Minimum		35.3	.46	2,550
Red Lauan	Occidental Negros	Average	28	76.9	.406	3,850
		Maximum		92.3	.43	4,270
		Minimum		63	.371	3,040
Palosapis	Laguna	Average	40	63.5	.399	3,530
		Maximum		85.4	.456	4,080
		Minimum		44.1	.343	2,780
Malugay	Mindoro	Average	34	55.8	.635	5,120
		Maximum		70.8	.713	6,040
		Minimum		46.6	.553	3,960
Sasalit	Zambales	Average	----	----	----	----
		Maximum				
		Minimum				
Liusin	Bataan	Average	.8	60.9	.71	5,220
		Maximum		63	.73	5,640
		Minimum		57.6	.70	4,860
Lumbayao	Basilan Island, Moro Province.	Average	----	----	----	----
		Maximum				
		Minimum				
Agoho	Tarlac	Average	56	44.2	.725	7,220
		Maximum		56.4	.762	8,760
		Minimum		35.3	.62	4,390
Do	do	Average	----	----	----	----
		Maximum				
		Minimum				
Do	do	Average	----	----	----	----
		Maximum				
		Minimum				
Mangachapuy	Albay	Average	----	----	----	----
		Maximum				
		Minimum				
Dao	Mindoro	Average	14	46.2	.602	5,070
		Maximum		62.7	.633	5,710
		Minimum		35.4	.55	3,770
Cupang	Palawan	Average	26	93	.285	2,070
		Maximum		128	.368	2,330
		Minimum		59.8	.259	1,630

grain of Philippine timber—Continued.

Moisture 20 to 35 per cent.				Moisture under 20 per cent.				Total number of tests.	Specific gravity of dry wood, all tests.
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).		
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24	31.5 34.8 28.3	0.857 .886 .82	6,410 7,330 5,000	-----	-----	-----	-----	38	.856 .886 .82
2	34 34 34	.806 .806 .806	4,410 4,540 4,290	-----	-----	-----	-----	62	.728 .806 .615
2	32.8 32.8 32.8	.883 .883 .883	7,140 7,310 6,980	12	14.5 16.5 12.1	0.87 .905 .85	8,630 9,560 7,800	48	.85 .905 .784
2	34.2 35 33.4	.674 .708 .64	5,720 6,240 5,340	-----	-----	-----	-----	42	.623 .708 .488
-----	-----	-----	-----	8	5 5.6 4.4	.836 .85 .821	9,290 10,640 7,190	26	.795 .85 .76
36	31.2 34.5 27.7	.826 .86 .796	8,020 8,730 6,840	52	4.9 6.4 3.4	.882 .942 .832	12,420 14,920 9,290	88	.859 .942 .796
4	24.2 28 20.5	.50 .546 .455	3,990 4,470 3,400	4	15.5 17.8 13.3	.534 .545 .523	4,150 4,470 3,530	38	.525 .572 .455
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18	22.1 35.9 20	.666 .71 .625	5,740 7,270 5,160	26	11.2 18.8 7.4	.683 .75 .62	8,080 10,930 4,830	78	.658 .75 .553
42	25.7 31.1 21.5	.89 .984 .742	9,290 11,890 6,600	34	11.3 15.8 8.7	.849 .995 .815	9,100 11,180 6,400	76	.872 .995 .742
-----	-----	-----	-----	-----	-----	-----	-----	8	.71 .73 .70
54	25.2 31.5 20.1	.551 .603 .483	5,480 6,390 4,520	52	12.5 19.7 5.3	.58 .671 .53	6,410 8,100 3,550	106	.565 .671 .483
-----	-----	-----	-----	-----	-----	-----	-----	56	.725 .762 .62
36	27 34.8 20.4	.858 .94 .78	5,770 7,770 4,330	-----	-----	-----	-----	36	.858 .94 .78
-----	-----	-----	-----	8	18.3 19.6 17.6	.909 .954 .93	7,370 8,580 5,010	8	.909 .954 .93
26	29.6 33.1 24.9	.726 .75 .51	7,730 8,280 6,950	-----	-----	-----	-----	26	.726 .75 .51
-----	-----	-----	-----	-----	-----	-----	-----	14	.602 .633 .55
-----	-----	-----	-----	-----	-----	-----	-----	26	.285 .368 .259

TABLE III.—*Shearing strength along the grain of Philippine timber.*

[Results averaged regardless of moisture content.]

Name.	Locality.		Number of tests.	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Lauan	Mindanao	Average	142	0.446	557
		Maximum		.488	934
		Minimum		.40	326
Do	Zambales	Average	69	.478	525
		Maximum		.529	873
		Minimum		.412	292
Almon	Occidental Negros	Average	34	.464	508
		Maximum		.52	737
		Minimum		.378	324
Apitong	Mindanao	Average	150	.645	669
		Maximum		.825	1,203
		Minimum		.56	240
Do	Zambales	Average	62	.687	757
		Maximum		.93	1,212
		Minimum		.588	298
Do	Occidental Negros	Average	20	.564	753
		Maximum		.581	997
		Minimum		.55	528
Guijo	Ambos Camarines	Average	110	.708	915
		Maximum		.82	1,324
		Minimum		.629	366
Do	Mindoro	Average	98	.697	824
		Maximum		.806	1,500
		Minimum		.596	561
Molave	Near Laguna de Bay	Average	129	.784	914
		Maximum		.88	1,362
		Minimum		.69	357
Do	Ambos Camarines	Average	51	.784	839
		Maximum		.825	1,323
		Minimum		.716	403
Yacal	do	Average	150	.843	849
		Maximum		.94	1,665
		Minimum		.76	427
Narra	Near Laguna de Bay	Average	20	.563	678
		Maximum		.59	844
		Minimum		.535	456
Do	Cagayan	Average	59	.54	660
		Maximum		.77	1,225
		Minimum		.384	291
Tanguile	Unknown	Average	70	.471	647
		Maximum		.58	928
		Minimum		.355	326
Do	Zambales	Average	86	.491	555
		Maximum		.606	1,068
		Minimum		.405	288
Tanguile-balakbakan	Occidental Negros	Average	26	.509	602
		Maximum		.53	878
		Minimum		.479	380
Sacat	Lamao Forest Reserve, Bataan.	Average	14	.561	776
		Maximum		.585	1,055
		Minimum		.54	550
Do	Tarlac	Average	132	.616	850
		Maximum		.70	1,584
		Minimum		.478	466
Ipil	Ambos Camarines	Average	79	.793	904
		Maximum		.99	1,310
		Minimum		.68	458

TABLE III.—*Shearing strength along the grain of Philippine timber*—Continued.

[Results averaged regardless of moisture content.]

Name.	Locality.		Number of tests.	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Ipil	Mindoro	Average	90	0.673	948
		Maximum		.77	1,445
		Minimum		.56	410
Do	Palawan	Average	80	.807	753
		Maximum		.867	1,226
		Minimum		.75	525
Dungon	Ambos Camarines	Average	98	.852	1,253
		Maximum		.985	1,854
		Minimum		.723	672
Do	Masbate	Average	46	.85	1,298
		Maximum		.89	1,560
		Minimum		.816	925
Do.[a]	Mindanao	Average	44	.669	855
		Maximum		.707	1,102
		Minimum		.636	563
Malasantol	Unknown	Average	54	.646	720
		Maximum		.712	1,110
		Minimum		.608	409
Supa	do	Average	86	.71	898
		Maximum		.835	1,480
		Minimum		.61	520
Do	Tayabas	Average	118	.813	852
		Maximum		.955	1,380
		Minimum		.70	293
Balacat	Lamao Forest Reserve, Bataan.	Average	16	.517	486
		Maximum		.57	638
		Minimum		.478	300
Do	Tarlac	Average	117	.578	692
		Maximum		.66	1,281
		Minimum		.515	253
Macaasim	Unknown	Average	92	.717	916
		Maximum		.82	1,390
		Minimum		.667	376
Calantas	Albay	Average	34	.358	526
		Maximum		.379	870
		Minimum		.336	289
Do	Mindoro	Average	35	.527	778
		Maximum		.583	1,049
		Minimum		.492	455
Tindalo	Unknown	Average	20	.763	1,004
		Maximum		.864	1,460
		Minimum		.734	685
Do	Ambos Camarines	Average	56	.805	911
		Maximum		.866	1,507
		Minimum		.72	299
Do	Masbate	Average	36	.772	905
		Maximum		.813	1,226
		Minimum		.68	496
Amugis	Mindoro	Average	60	.692	824
		Maximum		.75	1,762
		Minimum		.621	396
Do	Palawan	Average	14	.675	851
		Maximum		.753	1,107
		Minimum		.613	641

[a] This is not the wood commonly known as dungon but is often sold under that name.

TABLE III.—*Shearing strength along the grain of Philippine timber*—Continued.

[Results averaged regardless of moisture content.]

Name.	Locality.		Number of tests.	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Acle	Tarlac	Average Maximum Minimum	36	0.63 .707 .598	686 1,270 420
Do	Zambales	Average Maximum Minimum	11	.579 .604 .553	778 1,190 443
Betis	Tayabas	Average Maximum Minimum	38	.856 .886 .82	1,168 1,555 598
Do	Ambos Camarines	Average Maximum Minimum	61	.728 .806 .615	819 1,243 474
Bansalagin	Unknown	Average Maximum Minimum	48	.85 .905 .784	1,098 1,865 695
Palo Maria	Zambales	Average Maximum Minimum	46	.623 .708 .488	856 1,581 528
Batitinan	Unknown	Average Maximum Minimum	26	.795 .85 .76	859 2,195 535
Aranga	Ambos Camarines	Average Maximum Minimum	82	.863 .942 .796	1,038 2,324 355
Banuyo	Masbate	Average Maximum Minimum	38	.525 .572 .455	596 1,065 287
Red Lauan	Occidental Negros	Average Maximum Minimum	28	.406 .43 .371	502 761 332
Palosapis	Laguna	Average Maximum Minimum	40	.399 .456 .343	472 790 288
Malugay	Mindoro	Average Maximum Minimum	78	.658 .75 .553	980 1,885 464
Sasalit	Zambales	Average Maximum Minimum	75	.872 .995 .742	1,176 1,938 708
Liusin	Bataan	Average Maximum Minimum	8	.71 .73 .70	886 1,388 543
Lumbayao	Basilan Island, Moro Province.	Average Maximum Minimum	104	.565 .671 .483	827 1,306 353

Table IV.—*Summary of mechanical tests on thirty-two species of American woods.*

[From Tables I, II, IV, V, and VI, Circular No. 15, Division of Forestry, United States Department of Agriculture.]

Kind of wood.	Specific gravity of dry wood.	Fiber stress at relative (apparent) elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Stress at rupture compression along the grain (pounds per square inch).	Stress at rupture shearing along the grain; not reduced for moisture (pounds per square inch).
Reduced to 15 per cent moisture.						
Longleaf pine	0.61	8,500	10,900	1,890	6,900	700
Cuban pine	.63	9,500	11,900	2,300	7,900	700
Shortleaf pine	.51	7,200	9,200	1,600	5,900	700
Loblolly pine	.53	8,200	10,100	1,950	6,500	700
Reduced to 12 per cent moisture.						
White pine	.38	6,400	7,900	1,390	5,400	400
Red pine	.50	7,700	9,100	1,620	6,700	500
Spruce pine	.44	8,400	10,000	1,640	7,300	800
Bald cypress	.46	6,600	7,900	1,290	6,000	500
White cedar	.37	5,800	6,300	910	5,200	400
Douglas spruce[a] (Oregon pine)	.51	6,400	7,900	1,680	5,700	500
White oak	.80	9,600	13,100	2,090	8,500	1,000
Overcup oak	.74	7,500	11,300	1,620	7,300	1,000
Post oak	.80	8,400	12,300	2,030	7,100	1,100
Cow oak	.74	7,600	11,500	1,610	7,400	900
Red oak	.73	9,200	11,400	1,970	7,200	1,100
Texan oak	.73	9,400	13,100	1,860	8,100	900
Yellow oak	.72	8,100	10,800	1,740	7,300	1,100
Water oak	.73	8,800	12,400	2,000	7,800	1,100
Willow oak	.72	7,400	10,400	1,750	7,200	900
Spanish oak	.73	8,600	12,000	1,930	7,700	900
Shagbark hickory	.81	11,200	16,000	2,390	9,500	1,100
Mockernut hickory	.85	11,700	15,200	2,320	10,100	1,100
Water hickory	.73	9,800	12,500	2,080	8,400	1,000
Bitternut hickory	.77	11,100	15,000	2,280	9,600	1,000
Nutmeg hickory	.78	9,300	12,500	1,940	8,800	1,100
Pecan hickory	.78	11,500	15,300	2,530	9,100	1,200
Pignut hickory	.89	12,600	18,700	2,730	10,900	1,200
White elm	.54	7,300	10,300	1,540	6,500	800
Cedar elm	.74	8,000	13,500	1,700	8,000	1,300
White ash	.62	7,900	10,800	1,640	7,200	1,100
Green ash	.62	8,900	11,600	2,050	8,000	1,000
Sweet gum	.59	7,800	9,500	1,700	7,100	800

[a] Actual test on "dry" matrial not reduced for moisture.

TABLE V.[a]—*Comparison of selected Philippine, Borneo, and American woods.*

Name.	Locality.	Compression along the grain.		Cross-bending.			
		Average per cent moisture.	Average stress at rupture (pounds per square inch).	Average per cent moisture.	Average modulus of rupture (pounds per square inch).	Average modulus of elasticity (1,000 pounds per square inch).	Average specific gravity of dry wood.
Aranga	Philippine Islands	4.9	12,420	5.6	17,920	2,419	0.859
Billian (Borneo ironwood).	Borneo	22.5	11,290	22.5	19,660	2,384	.96
Pignut hickory	United States	12	10,900	12	18,700	2,730	.78
Dungon	Philippine Islands	10.7	9,420	11.6	17,110	2,209	.857
Yacal	do	13.4	9,220	15.6	15,690	2,583	.843
Merabau (Borneo ipil)	Borneo	21	9,035	21	18,830	2,505	.965
White oak	United States	12	8,500	12	13,100	2,090	.80
Molave	Philippine Islands	12.7	8,330	10.4	8,580	1,614	.785
Guijo	do	14.6	7,940	13.7	15,150	2,158	.708
Salangan batu (Borneo yacal).	Borneo	27.6	7,420	27.6	12,325	2,027	.689
Apitong	Philippine Islands	14.4	7,250	14	11,620	2,144	.645
Longleaf pine	United States	15	6,900	15	10,900	1,890	.61
Ipil	Philippine Islands	17.7	6,570	18.1	6,980	1,383	.792
Lauan	do	12.4	6,180	10.4	9,760	1,653	.446
Oregon pine	United States	12	5,700	12	7,900	1,680	.51
California redwood	do	13.3	5,560	12.3	9,110	1,320	.445

[a] Table VI of the original report.

Appendix II.—Shipping Weights.[1]

In preparing the following table the air-dry weight was taken as the weight of the wood in its driest air-seasoned condition. Thoroughly air-dried wood has a moisture content ranging from 7 per cent to as high as 17 per cent of the weight of the same wood oven-dried. The weights here given were obtained by assuming that thoroughly air-dry wood contains 15 per cent of moisture, the corresponding increase being added to the specific gravity as obtained from oven-dried specimens. Very little wood comes to Manila air-dry, so that probably all the maximum weights and almost certainly all the minimum weights in the table will be lower than those of commercial lumber.

Where but one figure is given in a column, only a single specimen was tested.

Air-dry or shipping weight of forty-two woods.

Name of wood.	Per 1,000 feet B. M.		Pounds per cubic foot.	Kilos per cubic meter.
	Kilos.	Pounds.		
Agoho	1,720-2,668	3,785-5,869	46-70	736-1,120
Acle	1,536-1,964	3,380-4,320	41-52	656- 832
Almon	1,023-1,439	2,250-3,166	27-38	432- 608
Amugis	1,702-2,478	3,743-5,452	45-67	720-1,072
Apitong	1,527-2,833	3,359-5,667	40-68	640-1,088
Aranga	2,208-2,615	4,859-5,753	59-69	944-1,104
Balacat	1,430-1,831	3,146-4,029	38-46	608- 736
Balinghasay	1,291	2,840	34	544
Bangkal	1,527	2,359	40	640
Bansalagin	2,176-2,513	4,787-5,529	58-67	928-1,042
Banuyo	1,263-1,775	2,778-3,904	33-47	528- 752
Batete	2,053	4,517	54	864
Batitinan	2,110-2,386	4,642-5,250	56-63	896-1,008
Betis	1,708-2,459	3,758-5,410	45-65	720-1,040
Calantas	932-1,619	2,052-3,562	25-43	400- 688
Catmon	1,959	4,309	44	704
Cupang	720-1,022	1,584-2,248	19-27	304- 432
Dao	1,749-1,834	3,847-4,034	46-48	736- 788
Dungon	1,765-2,735	3,884-6,018	47-72	752-1,152
Guijo	1,654-2,277	3,639-5,010	44-60	704- 960
Ipil	1,555-2,751	3,421-6,053	41-73	656-1,168
Kamatog	1,605-2,308	3,530-5,078	43-61	688- 976
Lanutan	1,463	3,219	39	624
Lauan:				
Red	1,028-1,194	2,262-2,627	27-32	432- 512
White	909-1,157	1,999-2,245	24-31	384- 496
Liusin	1,945-2,027	4,278-4,460	51-54	816- 864
Lumbayao	1,340-1,862	2,949-4,096	35-49	560- 784
Macaasim	1,853-2,277	4,076-5,010	49-60	784- 960
Malasantol	1,687-1,978	3,712-4,351	45-52	720- 832
Malugay	1,536-2,082	3,380-4,580	41-55	656- 880
Mancono	3,316	7,295	89	1,424
Mangachapuy	1,527-2,082	3,359-4,580	40-55	640- 880
Molave	1,916-2,443	4,216-5,374	51-67	816-1,042
Narra	1,061-2,375	2,333-4,750	28-57	448- 912
Pabutan	1,999	4,398	58	848
Palosapis	1,023-1,591	2,250-3,500	27-42	432- 672
Sacat	1,326-1,945	2,918-4,278	35-51	560- 816
Sasalit	2,060-2,764	4,533-6,080	53-73	848-1,168
Supa	1,694-2,653	3,728-5,836	45-70	720-1,120
Tanguile	986-1,683	2,169-3,703	26-45	416- 720
Tindalo	1,888-2,405	4,154-5,291	50-64	800-1,024
Yacal	2,150-2,610	4,730-5,742	56-69	896-1,104

[1] Practically all the data are from tests made by Dr. F. W. Foxworthy.

Appendix III.—Grading Rules.[1]

PROPOSED GRADING RULES APPLYING TO THE PURCHASE AND SALE OF NATIVE LUMBER BY ALL DEPARTMENTS OF THE PHILIPPINE GOVERNMENT.

I. INTRODUCTION.

The following grading rules shall be applied in the inspection of all native lumber sold, purchased or used by any department of the Philippine Government; they shall also govern the inspection of any lumber sold by local dealers for export or for local use, if such lumber, by the terms of the contract, is to be inspected by an official inspector furnished by the Government of the Philippines. In such cases, copies of these rules will be supplied to both contracting parties. In case foreign purchasers wish to make special stipulations for grading lumber which is to be put to uses requiring special qualifications, provided such stipulations are agreed to by the local dealers furnishing the lumber and provided the Bureau of Forestry finds nothing unreasonable in them, the official inspectors shall be guided by these stipulations in making their inspections. In such cases, the conditions of the contract must be clearly understood between the three interested parties, that is, the two contracting parties and the Bureau of Forestry, before the latter will authorize any inspection. For the present, such inspections will be made only at or near Manila; for points other than Manila an inspector may be detailed in special cases, provided one is available.

The exact grade must be specified in every contract, order or requisition for lumber. Such terms as "first-class lumber" have no specific meaning and no attention will be paid to them. If no grade as defined in the following rules is specified, the purchaser or requisitioner will have no recourse but to accept lumber as furnished, provided it be not of a grade lower than merchantable or, if tongue-and-groved or rustic, not lower than common.

Lumber in the rough must be accepted as graded and not subject to any change of grade resulting from milling or other causes subsequent to inspection.

II. GENERAL INSTRUCTIONS.

Standard sizes.—The English system of measurement will be used in all transactions in manufactured lumber.

> NOTE.—Dimensions should be indicated as follows: First, thickness in inches; second, width in inches; third, length in feet. Example: 2 in.$\times$18 in.$\times$22 ft. or $2'' \times 18'' \times 22'$. When it is understood that all dimensions are given in this order, the abbreviations or signs for the words "inches" and "feet" are frequently omitted, thus: $2 \times 18 \times 22$, also written 2×18—22.

The following are to be considered standard sizes and to such the rules will be applied strictly. Lumber of extraordinary lengths and widths for

[1] For the origin and object of these grading rules, see Part I, p. 15.

special uses will be inspected largely with a view to its fitness for the use for which it is intended:

1″×4″, 6″, 10″, 12″—10′ to 24′.
2″×3″, 4″, 8″, 10″, 12″—10′ to 24′.
3″×4″, 6″, 8″, 10″, 12″—12′ to 32′.
4″×4″, 6″, 8″, 10″, 12″—12′ to 32′.
6″×6″, 8″, 10″, 12″—12′ to 36′.
8″×8″, 10″, 12″—12′ to 36′.
10″×10″, 12″—12′ to 36′.
12″×12″—12′ to 36′.

It is understood that these sizes apply to unseasoned lumber and are subject to a certain amount of shrinkage in the process of seasoning.

In all lumber under 1 inch in thickness, each square foot of surface is counted as 1 board foot; in lumber over 1 inch in thickness, the measurement in board feet is the actual volume of the piece.

Surfaced lumber in sizes less than 4 inches in thickness is finished ⅛ inch less than the nominal size for each side surfaced, except for 1, 1¼ and 1½ inch stock, which, surfaced on both sides, is reduced to 13/16 inch, 1 1/16 and 1 5/16 inch, respectively. In sizes 4 inches and over in thickness, ¼ inch less than the nominal size for each side surfaced is allowed. Tongue-and-grooved stuff, ship-lap, and rustic siding are finished: In 4 inch widths or less, ⅜ inch less than nominal width and ⅛ inch less than nominal thickness; 6 and 8 inch widths, ⅝ inch less than nominal width. Tongue-and-groove and rustic are usually surfaced on one side only; when surfaced two sides on special order, they will be ¼ inch less than nominal thickness.

When ordering lumber full dimension after surfacing, it is understood that the nearest stock size or such sizes as will cut with the least possible waste in order to furnish the dimensions ordered, will be charged for; furthermore, if by the terms of a contract full dimensions in the rough are stipulated, no allowance for shrinkage or scant dimensions will be made.

Moldings made from standard sizes or rough stock will run about ¼ inch less in width and thickness than the nominal rough size.

An inspector cannot be held responsible for the degree of seasoning of any lot of lumber, as no superficial examination can determine the amount of moisture in timber; nor can he be held responsible for shrinkage, splitting, or checking due to seasoning subsequent to inspection.

Torn and slivered grain in finished lumber, caused by planing, will reduce lumber one grade regardless of all other qualifications.

When any species of wood named[1] in Classes A, B, and C is intended to be used for some purpose other than those indicated in the names of the classes, it will be graded according to the rules of the class to which it is transferred.

In interpreting the grading rules, the appendix shall guide the inspector in applying the rules to any given species, the notes in the appendix being in the nature of modifications intended to facilitate or regulate the application of the rules to a given species according to its individual peculiarities.

III. DEFINITIONS.

The following terms, where used in the rules and appendix, will be understood as here defined.

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[1] Originally a list of names was given with each class, the list being based on the commonest use of each species, but these lists were considered to be too inelastic; the class in which a species is included, for purposes of grading, is determined in each individual case by the use for which the lot in question is intended.

Checks (*or heart cracks*).—Cracks passing radially through or near the heart of the log and sometimes extending to the outside; in sawn timber not always to be distinguished from shakes and splits.

Corner.—One of the angles dividing the edges and faces of a board or two surfaces of a dimension timber.

Edge.—The narrow surfaces of a board.

Face.—In rough boards, or in boards surfaced on both sides, either of the two broad surfaces of a board; but when only one side is surfaced, "face" is understood to mean the surfaced side.

Heart cracks.—(*See* Checks.)

Knots.—A round knot is one which is sawn through at right angles or nearly so, showing as a circle or oval on the surface.

A spike knot is one which is sawn through lengthwise, showing as a more or less broad streak across the surface.

Mill run.—Lumber as sawn from logs, without grading, but excluding slabs.

Pinholes.—Holes made by small boring beetles, usually about the diameter of the head of a common pin.

Pitch pockets and pitch seams.—Cavities caused by knots, shakes, checks, etc., more or less completely filled with resin.

Random lengths.—This expression means that a lot of lumber may consist of any and all standard lengths at the option of the seller; in addition, odd lengths may be admitted when explicitly stated in contract.

Random widths.—Has the same application as Random lengths.

Sapwood.—Sound sapwood is sapwood free of wormholes, rot, and checks.

Bright sapwood is sound sapwood free of any stain or discoloration, it being understood that superficial discoloration caused by exposure, and which can be removed by one cut of the planer, is not considered a defect.

Season checks (*or surface checks.*)—Superficial cracks caused by shrinkage of timber on the surface, due to rapid drying, especially when fresh sawn lumber is exposed to the weather.

Shakes.—Circular cracks sometimes existing in the living tree, sometimes caused by shocks received in felling; they may sometimes plainly appear as shakes in the sawn lumber, but sometimes are not to be distinguished from checks and splits, according to the way the lumber is sawn from the log.

Splits.—Cracks in the ends of boards or dimension timbers, caused by rapid drying at the ends, or by rough usage in milling and transporting.

Surface.—Any side of a dimension timber.

Surface checks.—(*See* Season checks.)

Wane.—A beveled edge of a board or plank as sawn from an unsquared log, the bevel being caused by the curvature of the log.

Wormholes.—Holes ranging from $\frac{1}{8}$ to $\frac{1}{2}$ inch.

IV. ABBREVIATIONS OF TECHNICAL TERMS IN COMMON USE.

S 1 S.—Surfaced—that is, machine planed on one side; always understood, in any lumber not of square cross section, to mean one of the two broad faces.

S 1 S 2 E.—Surfaced on one face and two edges.

S 2 S.—Surfaced on two sides; always understood to mean the two broad faces.

S 2 S 1 E.—Surfaced on two faces and one edge.

S 4 S.—Surfaced on four sides.

S 1 E.—Surfaced on one edge.

S 2 E.—Surfaced on both edges.

S 1 S 1 E.—Surfaced on one face and one edge.

T & G.—Tongue and grooved (understood in practice to be S 1 S).

T & G, S 2 S.—Tongue and grooved and surfaced both sides.

T & G & B.—Tongue and grooved and beaded; the bead is made on the tongued edge and a chamfer on the grooved edge to meet bead of next piece; understood to be surfaced and beaded one side only.

T & G & B, S 2 S.—Tongue and grooved and beaded one side, opposite side surfaced.

T & G & B 2 S.—Tongue and grooved and beaded, and surfaced both sides.

T & G, B & C B.—Tongue and grooved, beaded, and center beaded; understood to be S 1 S; further operations are indicated as for T & G & B.

VB.—V-beaded, that is chamfered along both edges to form a V-groove.

B. M.—Board measure; example: 2,600 feet B. M.

Lin. ft.—Lineal feet of length, regardless of width and thickness.

Sup. Ft.—Superficial feet, that is square feet of surface regardless of thickness.

M.—One thousand (understood to mean 1,000 board feet, or 1,000 feet B. M.)

V. GRADING RULES.

CLASS A.—*Light construction timbers.*

Clear.—Shall be sound lumber well sawn on at least three sides, free of wane, large or loose round knots, of spike knots, rot or dry rot, and of pinholes, wormholes, and shakes or checks when shown on more than one side, except in lumber 2 inches or less in thickness, which must be free of shakes or checks on both faces.

Clear lumber will allow:

1. In 2 inches or less in thickness: Bright sapwood showing only on one face and one edge, and not exceeding 10 per cent of the area of the face; pinholes showing on one face only not exceeding six to the square foot; sound round knots not over 1 inch in diameter and far enough apart to cut 3 feet clear between any two knots; splits not to exceed 1 foot in length in 16-foot boards, other lengths in proportion; variations in sawing not to exceed 1/16 inch per inch of thickness nor 1/8 inch per foot of width; superficial season checks, unless sufficiently severe to impair strength or appearance of the piece, not to be considered a defect.

2. Over 2 inches in thickness: Sound sapwood on any two faces not to exceed 10 per cent of the area of two adjoining surfaces affected; pinholes on two adjoining surfaces; sound round knots as in 2 inch lumber; variations as in 2 inch lumber; superficial season checks as in 2 inch lumber.

Select.—Shall be sound lumber, well sawn, free of loose or rotten round knots, of spike knots, rot or dry rot, and of sapwood, shakes, checks, and splits, except as specified below.

Select lumber will allow:

1. In lumber 2 inches or less in thickness: Sound sapwood on both faces not to exceed 20 per cent of the area of one face and 10 per cent of one edge; pinholes not to be considered a defect unless so numerous as to affect seriously the strength or appearance of the piece; sound round knots not over 2 inches in diameter; wane on one corner only, not to exceed 1/2 inch in width nor 1/6 of the length of the piece; splits as in

"Clear;" variations in sawing not to exceed $\frac{1}{16}$ inch per inch of thickness nor $\frac{1}{8}$ inch per foot of width; superficial season checks as in "Clear."

2. Over 2 inches in thickness: Sound sapwood not to exceed 20 per cent of the cross section of the piece; sound round knots or sound spike knots of any size, except if so situated as to impair the strength of the piece; wane on not more than two corners, not exceeding 1 inch in width on any face nor one-sixth the length of the piece; variations in sawing not to exceed $\frac{1}{8}$ inch per 2 inches of thickness (under no circumstances to exceed $\frac{1}{2}$ inch), or $\frac{1}{8}$ inch per 12 inches of width; shakes or checks if not showing on more than one face nor more than 1 inch in depth; splits as in "Clear;" pinholes and superficial season checks not considered defects, unless seriously impairing strength or appearance of piece.

Merchantable.—Shall be sound lumber, free from defects not specified below, and suitable for general ordinary construction. In this grade mixed species will be admitted, provided the order, contract, or requisition states nothing to the contrary and provided there is no admixture of species inferior in strength or durability, or different in color from the ordinary kinds of lauan.

Merchantable lumber will allow:

1. In 2 inches or less in thickness: Sound sapwood without limit; sound knots of any size; shakes or checks if not large enough to impair seriously the strength of the piece; wane on not more than two corners, not exceeding $1\frac{1}{2}$ inches in width on any one face, nor exceeding one fourth the length of the piece; splits not to exceed $\frac{1}{10}$ the length of the piece; pinholes or wormholes, if not sufficiently numerous to impair seriouly the strength of the piece; variations in sawing as in "Select."

2. More than 2 inches in thickness: Sound sapwood without limit; sound knots of any size; shakes or checks not extending clear through the piece and not affecting seriously its strength; wane as in 2-inch lumber; splits as in 2-inch lumber; pinholes or wormholes as in 2-inch lumber; variations in sawing as in "Select."

Common.—Same as in Class B.

CLASS B.—*Strong construction timber.*

Clear.—Shall be sound lumber, well sawn on at least three sides, free of wane, large or loose round knots and spike knots, rot or dry rot, and of pinholes, wormholes, shakes, and checks when shown on more than one side, except in lumber 2 inches or less in thickness, which shall be free of shakes or checks on both faces.

Clear lumber will allow:

1. In lumber 2 inches or less in thickness: bright sapwood showing on only one face and one edge and not exceeding 10 per cent of the area of the face; pinholes showing on one face and not exceeding six to the square foot; sound round knots not over 1 inch in diameter and far enough apart to cut 3 feet clear between any two knots; splits not to exceed 1 foot in length in 16-foot boards, other lengths in proportion; variations in sawing not to exceed $\frac{1}{16}$ of an inch per inch of thickness nor $\frac{1}{8}$ inch per foot of width; superficial season checks, unless sufficiently severe to impair materially the strength or appearance of the piece.

2. In lumber over 2 inches in thickness: Sound sapwood on any two adjoining surfaces not to exceed 10 per cent of the area of the faces affected (except as specified for certain species in appendix); pinholes on two faces; wormholes on two faces, not to exceed six to every square

foot of surface of faces affected (except as specified for certain species in appendix); sound round knots as in 2-inch lumber; variations in sawing as in 2-inch lumber except as in appendix; season checks as in 2-inch lumber.

Select.—Shall be sound lumber, well sawn, free of loose or rotten round knots, or spike knots, of rot or dry rot, and of sapwood, shakes or checks, except as specified below.

Select lumber will allow:

1. In lumber 2 inches or less in thickness: bright sapwood showing on only one face and one edge and not exceeding 10 per cent of the area of the face; pinholes showing on one face and not exceeding six to the square foot; if pinholes and sapwood are both present, these defects shall be confined to the same side (see appendix); pinholes unless materially affecting the strength or appearance of the piece on one side only; sound round knots not over 2 inches in diameter; wane on one corner, not to exceed ½ inch in width nor one-sixth of the length of the piece (except as specified in appendix); splits as in "Clear;" variations in sawing not to exceed ⅛ inch per inch of thickness (in no case to exceed ½ inch) nor ¼ inch per 12 inches of width; superficial season checks as in "Clear."

2. In lumber over 2 inches in thickness: Sound sapwood not to exceed 20 per cent of the cross section of the piece (except as specified in appendix); sound round or spike knots; wane on two corners, not exceeding 1 inch in width on any face nor ⅙ the length of the piece (except as in appendix); variations in sawing not to exceed ⅛ inch per 2 inches of thickness (in no case to exceed ½ inch) or ⅛ inch per 12 inches of width; shakes or checks if not showing on more than one face nor more than 1 inch in depth; splits as in "Clears;" pinholes and superficial season checks if not materially impairing the strength or appearance of the piece.

Merchantable.—Merchantable lumber shall be sound, free from defects not specified below and suitable for general strong construction.

Merchantable lumber will allow:

1. In lumber of 2 inches or less in thickness: Sapwood without limit except as in appendix; sound knots as in Class A; shakes or checks as in Class A, except as in appendix; wane as in Class A, except as in appendix; splits as in Class A; pinholes and wormholes as in Class A, except as in appendix; variations in sawing as in Class A.

2. Over 2 inches in thickness: Sound sapwood as in Class A, except as in appendix; knots, shakes or checks as in Class A; wane, splits and pinholes, or wormholes as in 2-inch lumber; variations in sawing as in Class A.

Common.—Any lumber not coming up to requirements of merchantable, but still fit for rough or temporary construction purposes, box lumber, form lumber, etc.

Class C.—*Furniture and interior finish woods.*

Clear.—Shall be sound lumber, well sawn on at least three sides, free of wane (except as in 2), of loose or rotten knots, rot or dry rot, and of pinholes, wormholes, shakes, and checks showing on more than one side, except in lumber 2 inches or less in thickness, which shall be free of shakes and checks on both faces.

Clear lumber will allow:

1. In 2 inches or less in thickness: No sapwood in any species having sapwood distinctly inferior to heartwood (see appendix); no pinholes; no wormholes; sound round knots not exceeding 1 inch in diameter and not

to exceed one to every 4 square feet of surface, except clusters of sound small knots which are allowed without limit, provided they do not affect the strength of the piece; splits not to exceed 1 inch in length to each foot of length of the piece; no wane; variations in sawing not to exceed 1/16 inch per inch of thickness nor 1/8 inch per foot of width; no shakes or heartchecks; superficial season checks, unless sufficiently numerous or deep to affect seriously the strength or appearance of the piece.

2. Over 2 inches in thickness: No sapwood in any species having sapwood distinctly inferior to heartwood; pinholes or wormholes on one surface; sound knots not exceeding 1½ inches in diameter and clusters of small knots, provided neither seriously impairs the strength of the piece; splits not to exceed 1 inch in length to each foot of length of the piece; shakes or heartchecks on one face, provided they do not extend through more than one-fourth of the thickness nor more than one-eighth of the length of the piece; variations in sawing not to exceed 1/16 inch per inch of thickness nor ¼ inch per foot of width; superficial season checks as in 1-inch lumber; wane on one edge only, not to exceed 1 inch in width on either surface affected, nor one-fourth the length of the piece.

Selects.—Select lumber shall be sound, well sawn on at least three sides, free of large, loose, or rotten knots, rot or dry rot, and of pinholes, wormholes, shakes and checks, except as specified below. It is understood that one surface must be clear.

Select lumber will allow:

1. In 2 inches or under; sapwood on one face not to exceed 10 per cent of the area of the face; pinholes or wormholes on one face only; sound knots not exceeding 1½ inches in diameter and clusters of small knots, provided neither seriously impairs the strength of the piece; splits not to exceed 1 inch in length for each foot of length of the piece; variations in sawing not to exceed 1/8 inch per inch of thickness (in no case to exceed ½ inch) nor ¼ inch per foot of width; shakes or heartchecks on one face only not to exceed one-fourth of the thickness nor one-eighth of the length of the piece; wane on one face only, not to exceed in width the thickness of the piece, nor in length one-fourth the length of the piece; season checks on both faces, if not sufficiently numerous or deep to affect seriously the strength or appearance of the piece.

2. Over 2 inches in thickness: Sapwood on one edge and one face only, not to exceed 10 per cent of the two surfaces affected; pinholes and wormholes on two adjacent surfaces; sound knots not to exceed 2 inches in diameter; splits not to exceed 1 inch in length per foot of length of the piece; shakes and heartchecks on two adjacent surfaces, provided they run approximately parallel to the edges, and do not exceed one-fourth of the thickness nor one-fourth of the length of the piece; wane on one edge only, not to exceed 1½ inches in width on either face affected, nor ¼ of the length of the piece; variations in sawing not to exceed 1/16 inch per inch of thickness nor ¼ inch per foot of width.

Merchantable.—Merchantable lumber shall be sound, well sawn on three sides, free from defects except as specified below.

Merchantable lumber will allow:

1. In 2 inches or less in thickness: Sound sapwood on one face only, not to exceed 20 per cent of the area of the face; pinholes and wormholes on one face; sound knots or clusters of small knots; shakes and heartchecks on one face only; splits not to exceed 1 inch in length per foot of length of the piece; wane on one edge only not to exceed one-fourth the width of the piece nor one-third the length of the piece; superficial season checks not

a defect; variations in sawing not to exceed ⅛ inch per inch in thickness nor ¼ inch per foot of width.

2. Over 2 inches in thickness: Sound sapwood on two sides not to exceed 20 per cent of either face (except as specified in appendix); sound knots of any size, provided they do not materially impair the strength of the piece; shakes and checks, if approximately parallel to edges of piece and of a depth not exceeding one-half its thickness; wane on not more than two edges not to exceed in width one-fourth of any side affected; splits not to exceed in length 1 inch for every foot of length of the piece; pinholes not considered a defect; wormholes not considered a defect, unless so grouped as to seriously impair the strength of the piece; variations in sawing not to exceed ¼ inch in the thickness nor ¼ inch per foot of width (in no case to exceed ½ inch).

VI. APPENDIX.

Agoho.—Sapwood practically same as heartwood; in large dimension stuff especially, sapwood need not be considered in grading.

Acle.—Rules as to sapwood must be observed very strictly in grading acle.

Acleng-parang.—Same as acle.

Almon.—Sapwood not to be considered, except in "Clear" and "Select" grades.

Alupag.—Sapwood of good quality, admissible without limit except in "Clear" grade.

Amugis.—Rules as to sapwood to be applied strictly.

Anubing.—Rules as to sapwood to be applied very strictly.

Apitong.—Rules as to sapwood to be applied very strictly only in "Clear" and "Select".

Pitch pockets and pitch seams are very common in this wood. "Clear" will not allow pitch pockets and pitch seams; "Select" will allow pitch seams not over ⅛ inch wide, not over 6 inches long, not deeper than one-fourth the thickness of the piece, and there shall not be more than four such seams in a piece 16 feet in length. "Merchantable" will allow pitch seams not over ¼ inch wide, not longer than one-third of the length, nor deeper than one-half the thickness of the piece. One such pitch seam or its equivalent allowed in each piece, provided that such seam, or several small seams, run approximately parallel to the edges of the piece.

Aranga.—Sapwood not a defect.

Bacauan.—Rules as to sapwood to be applied strictly.

Bansalagin.—Sapwood not a defect.

Banuyo.—Rules as to sapwood to be observed very strictly.

Batete.—Same as banuyo.

Baticulin.—Regulations regarding sapwood to be interpreted liberally, except when uniformity of color is necessary.

Batino.—Sapwood not a defect.

Batitinan.—Regulations regarding sapwood to be observed strictly.

Betis.—Sapwood not a defect.

Binggas.—Sapwood not a defect.

Bitanhol.—Regulation regarding sapwood to be observed strictly.

Bolong-eta.—When used for ornamental furniture, inlaying, etc., sapwood to be excluded strictly according to rules, unless explicitly admitted by terms of requisition or contract; when used for construction, unlimited sapwood not a defect.

Calamansanay.—Sapwood not a defect.

Calantas.—According to rule.

Calumpit.—According to rule.

Camagon.—Same as bolong-eta.

Catmon.—Sapwood not a defect.

Dungon.—When used in contact with ground or much exposed to elements, rules regarding sapwood to be very strictly observed.

Dungon-late.—Same as dungon.

Ebony.—Black heartwood only to be admitted, unless terms of contract or requisition explicitly admit sapwood.

Guijo.—According to rule.

Ipil.—Sapwood very perishable; rules to be observed very strictly.

Lanete.—Sapwood not a defect. This wood is much subject to staining. Stained or "blued" wood not to be admitted in "Clear" or "Select".

Lauan, white.—According to rule.

Lauan, red.—This wood has often a very light, soft, and punky heart which must be excluded from "Clear" and "Select," and from "Merchantable" in so far as it impairs perceptibly the strength of the piece. Sapwood according to rule.

Lumbayao.—Same remarks as lauan, red.

Macaasim.—According to rule.

Malacadios.—Sapwood no defect, unless uniformity of color is desired.

Malugay.—Rules regarding sapwood to be observed strictly.

Mancono.—Sapwood so small as to be negligible.

Mangachapuy.—Rules in regard to sapwood to be strictly observed.

Molave.—In molave all lengths from 6 feet up will be considered stock sizes. Molave being a tree with a generally short and very irregular trunk, and the timber being most generally used for structural purpose, where appearance is to be considered less than strength, the rules regarding wane may be interpreted very liberally. The sapwood is small and but little inferior to the heartwood and need not be considered in grading. Large wormholes are common in molave, but generally very few in any one log; if lumber is otherwise up to grade, large wormholes are not considered a defect unless so grouped as materially to weaken the piece.

Narra.—All lengths from 6 feet up will be considered stock lengths. Rules as to wane and sapwood are to be very strictly observed.

Nato.—Sapwood but little inferior to heartwood; rules to be interpreted liberally.

Pagatpat.—Rules regarding sapwood to be observed strictly in "Clear" and "Select."

Palomaria.—Rules regarding sapwood to be strictly observed.

Sasalit.—Sapwood small and scarcely inferior to heartwood.

Appendix IV.—DURABILITY OF SAPWOOD.

Woods may roughly divided into three classes: (1) Durable woods having a sapwood little if at all inferior to the heartwood, (2) durable woods having a poor sapwood, and (3) woods in which neither heartwood nor sapwood is durable. When used under severe conditions the choice between including or discarding the sapwood is easy. In many species, however, having sapwood that is readily attacked by decay under severe conditions, it may yet be sufficiently resistant to insects when it is seasoned so that it can be used with perfect safety for interior trim, furniture, cabinetwork, and tools or instruments; in short, for all purposes where it is not exposed to contact with the earth or to the influence of the weather. And finally there are many instances where the sapwood is actually preferred to the heartwood or where it is desired to use the two together. The sapwood of the camagons is preferable to the heartwood for many kinds of tools and instruments on account of its greater toughness and flexibility, while for cabinetwork species with strongly contrasting heartwood and sapwood are often chosen for ornamental effects, and for preservative treatment those species should be purposely chosen which have a large and porous sapwood because it absorbs the creosote or other preservatives more readily than does the denser heartwood.

In view of these considerations it is easily seen that to decide whether sapwood should or should not be used no categorical classification of all woods for all purposes is possible. It is believed that the following lists will be of service to the average wood user in deciding the question in many cases:

I. General construction, posts, poles, sills, ties, all purposes where wood is severely exposed:

SAPWOOD POOR.

Acle.
Acleng-parang.
Amamanit.
Amugis.
Anislag.
Antipolo.
Anubing.
Apitong.
Bahai.
The Bacauans.
Balinghasay.
Banuyo.
Batete
Batitinan.
Calumpit.
Caña-fistula.
Dalinsi.
Dao.
Dungon.
Himbabao.
Ipil.
Kamatog.
Kariskis.
Kasai.
Kubi.
Lamio.
Lumbayao.
Madre-cacao.
Malambingan.
Malugay.
Narig.
Narra.
Pagsahingin.
Palosapis.
Sacat.
Salingkugi.
Talisay.
Talisay-gubat.
Tamayuan.
Tanglin.
Tindalo.
Toog.
Unik.

SAPWOOD FAIR.

Alintatatau.
Bakan.
Banaba.
Bangkal.
Bangulo.
The Baticulins.
Batukanag and all other *Aglaias*.
Bitanhol.
Calamansanay.
Catmon.
Guijo.
Hambabalud.
Kaburo.
Kamingi.
Kato.
Lamog.
Lanutan.
Macaasim.
Malabunga.
Malapinggan.
Mangachapuy.
Manggis.
The Natos.
Pagatpat.
Salakin.
Supa.
Tuai.
Urung.
The Yacals.

SAPWOOD LITTLE INFERIOR OR EQUAL TO HEARTWOOD.

Agaru.	Binukau and all other *Garcinias.*	Miao.
Agoho.	Bulala.	Molave.
Almaciga.	Guyungguyung and other *Cratoxylons.*	The Oaks.
Alupag.	Kayatau.	Palomaria.
Alupag-amo.	Lago.	The Pototans.
Aranga.	Liusin.	Santol.
Banaui.	Malabayabas.	Sasalit.
Bansalagin.	Malacadios.	Sudiang.
Batino.	Malasantol.	Tabau.
Bayok.	Mancono.	Tambalau.
Betis.		Tambulian.
Binggas.		Tucang-calao.

II. In the case of trees that have not a very durable heartwood nor, on the other hand, a very large sapwood, the removal of the latter is a matter of little importance, especially if the lumber is to be well painted, treated with preservatives, or used for such purposes as foundation piling where insects and fungi are excluded, or for temporary construction, concrete forms, etc., where cheapness is more important than durability. Practically the only woods of this class that are sufficiently abundant to be of any importance are the lauans:

Almon.	Malaanonang.	Red Lauan.
Bagtican.	Malakayan.	Tanguile.
Danlig.	Mangasinoro.	Tiaong.
Kalunti.	Mayapis.	White Lauan.

When any of these are used for interior trim or furniture, the sapwood should be removed, as it is very liable to attacks of pin-hole and shot-hole beetles, even when thoroughly seasoned.

III. Woods having strongly contrasted heartwood and sapwood, used for ornamental purposes; the sapwood, though not durable under severe conditions, is very rarely attacked by insects when seasoned. Such are:

Api-api.	Dalinas.	Kuyuskuyus.
Ata-ata.	Dugkatan.	Malatapai.
Bolong-eta.	Ebony.	Pahutan.
Camagon.	Kamuning.	Tamayuan.

GENERAL INDEX.

[NOTE.—The various uses of wood have not been separately indexed, as they are discussed in alphabetical order in Part III, pages 59 to 83.]

INDEX OF SCIENTIFIC NAMES.

[Synonyms in *italics*.]

INDEX OF COMMON NAMES.

[NOTE.—Official names of tree species are printed in heavy type.]